Draft

Revised

Total Maximum Daily Load Evaluation

for

Twenty-Eight Stream Segments

in the

Altamaha River Basin

for

Dissolved Oxygen

Submitted to:
The U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

Submitted by:
The Georgia Department of Natural Resources
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EXECUTIVE SUMMARY

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies were historically placed into one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process and were published in 2000 and 2006 *Water Quality in Georgia* Reports (Georgia EPD, 1998-1999, and Georgia EPD 2004-2005).

Some of the 305(b) partially and not supporting water bodies were also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and to restore and maintain water quality.

The State of Georgia identified twenty-eight (28) stream segments, located in the Altamaha River Basin, as water quality limited due to dissolved oxygen (DO). These waterbodies were included in the State's 2000 and 2006 303(d) lists. This revised report presents the DO TMDLs for these segments.

Part of the TMDL analysis is the identification of potential source categories. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of oxygen demanding substances on land surfaces that wash off as a result of storm events.

The process of developing the DO TMDL for the Altamaha River Basin included developing computer models for the listed segments. Georgia DOSAG, a steady state water quality model developed by the Georgia Environmental Protection Division (GA EPD) was used for the freshwater segments. These models were calibrated to data collected in the Altamaha River Basin in the summer of 1999 and 2004.

Management practices may be used to help reduce and/or maintain the Ultimate Oxygen Demand (UOD) loads. These include:

- Compliance with the requirements of the NPDES permit program; and
- Application of Best Management Practices (BMPs) appropriate to nonpoint sources.

The amount of oxygen demanding substances delivered to a stream is difficult to determine. However, by requiring and monitoring the implementation of these practices, such efforts will improve stream water quality and represent a beneficial measure of TMDL implementation.

River Basin Name: **Altamaha**

Table E-1 provides the twenty three (23) stream segments located in the Altamaha River Basin that were identified as water quality limited due to DO on Georgia's 2000 303(d) list.

Table E-1 2000 303(d) Listed Segments for Dissolved Oxygen in the Altamaha River Basin

STREAM SEGMENT	LOCATION	SEGMENT LENGTH (Miles)	DESIGNATED USE	ASSESSMENT UNIT ID
Alex Creek	Mason Cowpen Branch to Altamaha River (Wayne Co.)	3	Fishing	GAR030701060503
Big Cedar Creek	Little Cedar Creek to Ohoopee River (Johnson Co.)	3	Fishing	GAR030701070102
Cobb Creek	Oconee Creek to Altamaha River (Toombs Co.)	13	Fishing	GAR030701060102
Doctors Creek	U/S Jones Creek (Long Co.)	5	Fishing	GAR030701060405
Jacks Creek	US Hwy 1 to Ohoopee River (Emanuel Co.)	9	Fishing	GAR030701070303
Jones Creek	Still Creek to Doctor's Creek (Long Co.)	11	Fishing	GAR030701060404
Little Ohoopee River	Gully Branch to Nealey Creek (Washington Co.)	14	Fishing	GAR030701070201
Little Ohoopee River	Nealey Creek to Sardis Creek (Johnson Co.)	15	Fishing	GAR030701070202
Little Ohoopee River	Sardis Creek to Ohoopee River (Emanuel Co.)	18	Fishing	GAR030701070203
Milligan Creek	Uvalda to Altamaha River (Montgomery /Toombs Co.)	11	Fishing	GAR030701060101
Oconee Creek	Headwaters to Cobb Creek (Montgomery/Toombs Co.)	11	Fishing	GAR030701060103
Ohoopee River	Neels Creek to Little Ohoopee River (Johnson/Emanuel Co.)	18	Fishing	GAR030701070103
Ohoopee River	Little Ohoopee River to US Hwy 292 (Emanuel/Candler/Tattnell Co.)	23	Fishing	GAR030701070304
Pendleton Creek	Sand Hill Creek to Reedy Creek (Treutlen Co.)	7	Fishing	GAR030701070401
Pendleton Creek	Wildwood Lake to Tiger Creek (Treutlen/Toombs Co.)	12	Fishing	GAR030701070402
Penholoway Creek	Little Creek to Altamaha River (Wayne Co.)	13	Fishing	GAR030701060403
Rocky Creek	GA Hwy 130 to Little Rocky Creek (Toombs Co.)	10	Fishing	GAR030701070505
Rocky Creek	Little Rocky Creek to Ohoopee River (Toombs/ Tattnall Co.)	11	Fishing	GAR030701070504

STREAM SEGMENT	LOCATION	SEGMENT LENGTH (Miles)	DESIGNATED USE	ASSESSMENT UNIT ID
Swift Creek	Old Normantown Rd. to Pendleton Creek (Toombs Co.)	5	Fishing	GAR030701070404
Ten Mile Creek	Little Ten Mile Creek to Altamaha River (Appling Co.)	13	Fishing	GAR030701060201
Thomas Creek	D/S CR203 to Ohoopee River (Tattnell Co)	12	Fishing	GAR030701070506
Tiger Creek	Little Creek to Pendleton Creek (Montgomery/ Toombs Co.)	16	Fishing	GAR030701070403
Yam Grandy Creek	D/S Crooked Creek (Emanuel Co.)	3	Fishing	GAR030701070305

Table E-2 identifies five (5) stream segments located in the Altamaha River Basin that were water quality limited due to DO and included on the State's 2006 303(d) list.

Table E-2. 2006-303(d) Listed Segments for Dissolved Oxygen in the Altamaha River Basin

STREAM SEGMENT	LOCATION	SEGMENT LENGTH (Miles)	DESIGNATED USE	ASSESSMENT UNIT ID
Cypress Creek	Rolands Pond to Ohoopee River (Johnson Co)	4	Fishing	GAR030701070104
Nealey Creek	Headwaters to Little Ohoopee River (Washington/Johnson Co)	9	Fishing	GAR030701070206
Ohoopee River	Dyers Creek to Big Cedar Creek (Washington/Johnson Co)	15	Fishing	GAR030701070101
Ohoopee River	Big Cedar Creek to Cypress Creek (Johnson Co)	2	Fishing	GAR030701070106
Sardis Creek	Headwaters to little Ohoopee River (Emanuel Co)	10	Fishing	GAR030701070207

Description of Analysis

The USGS water quality data collected in 1999 and 2004 and the identified DO impairments for Altamaha stream segments listed in Table E-1 and E-2, indicated that these impairments occurred during, and were limited to, summer months, low flow and high temperature conditions. Stream flows during periods of impairment were at, or below, 7Q10 (the minimum 7-day average flow that occurs once in 10 years on the average), which is consistent with the 3-year drought experienced in Georgia from 1998 to 2000. Since the observed DO impairments were clearly driven by persistent low flows and high temperatures, occurring over several summer months, a steady state modeling approach was adopted as appropriate for DO TMDL analysis.

Applicable Water Quality Standards

The applicable DO water quality standards for waters in the Altamaha River Basin are as follows:

> *Numeric - GA EPD*. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish. 391-3-6-.03(6)(c)(i). (GA EPD, 2021)
> *Natural Water Quality – GA EPD.* It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and best management practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation. 391-3-6-.03 (7). (GA EPD, 2021)
> *Natural Water Quality – EPA*. Where natural conditions alone create dissolved oxygen concentrations less than 110 percent of the applicable criteria means or minima or both, the minimum acceptable concentration is 90 percent of the natural concentration. (USEPA, 1986).

Due to naturally occurring low DO in the impaired segments, the EPA natural water quality standard was appropriate to support the proposed allocations. That is, if a model result showed a natural DO less than 5.0 mg/L, the natural model result would define the DO standard to be applied. In this case, the target would become 90 percent of the computed natural DO.

Technical Approach

Model Adopted: Georgia DOSAG – steady-state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from 1999 and 2004.

Calibration Conditions:
(1) USGS flows measured in 1999 and 2004.
(2) USGS Temperatures measured in 1999 and 2004.
(3) Point source DMR data for 1999 and 2004.
(4) SOD values for ‘mixed land uses’ based on year 2000 TMDLs for the South 4 Basins.
(5) Depths, velocities, kinetic rates, reaeration, and boundary conditions based on 1999 and 2004 USGS field data and/or GA EPD standard modeling practices.

Critical Conditions:
(1) 7Q10 flows recomputed to include data through 1998.
(2) Temperatures derived from historic trend monitoring data.
(3) Point source discharges at current permit limits.
(4) Same SOD for ‘mixed land uses’ as calibration conditions.
(5) Same depths, velocities, kinetic rates, reaeration, and boundary conditions as calibration conditions.

Natural Conditions:
(1) Same flows as critical conditions.
(2) Same temperatures as critical conditions.
(3) All point sources completely removed.
(4) SOD for natural (i.e., fully forested) land use based on year 2000 TMDLs for the South 4 Basins.

(5) Same depths, velocities, kinetic rates, reaeration, and boundary conditions as calibration conditions.

MOS: Implicit, based on the following conservative assumptions:

(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) All point sources discharge continuously at their NPDES permit limits for the same critical period.
(4) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 1999.
(5) Water depths are shallow, generally less than one foot, which aggravates the effect of SOD.
(6) Water velocities are sluggish, generally 0.5 fps or less, which intensifies the effect of BOD decay.

Seasonality: DO data showed no impairments outside of the high-temperature, low-flow conditions which occur during the summer months.

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Table E-3 Summary of TMDLs for Dissolved Oxygen Listed Segments in the Altamaha River Basin.

STREAM SEGMENT	LOCATION	WLA (lbs/day)	TMDL (lbs/day)
Alex Creek	Mason Cowpen Branch to Altamaha River (Wayne Co.)	0	719
Big Cedar Creek	Little Cedar Creek to Ohoopee River (Johnson Co.)	29	78
Cobb Creek	Oconee Creek (Toombs Co.)	1289	2482
Cypress Creek	Rolands Pond to Ohoopee River (Johnson Co)	0	44
Doctors Creek	U/S Jones Creek (Long Co.)	0	36
Jack's Creek	US Hwy 1 to Ohoopee River (Emanuel Co.)	0	47
Jones Creek	Still Creek to Doctor’s Creek (Long Co.)	115	176
Little Ohoopee River	Gully Branch to Nealey Creek (Washington Co.)	0	38
Little Ohoopee River	Nealey Creek to Sardis Creek (Johnson Co.)	0	120
Little Ohoopee River	Sardis Creek to Ohoopee River (Emanuel Co.)	0	212
Milligan Creek	Uvalda to Altamaha River (Montgomery /Toombs Co.)	0	542
Nealey Creek	Headwaters to Little Ohoopee River (Washington/Johnson Co)	0	12
Oconee Creek	Headwaters to Cobb Creek (Montgomery/Toombs Co.)	0	364
Ohoopee River	Dyers Creek to Big Cedar Creek (Washington/Johnson Co)	142	203
Ohoopee River	Big Cedar Creek to Cypress Creek (Johnson Co)	171	283
Ohoopee River	Neels Creek to Little Ohoopee River (Johnson/Emanuel Co.)	171	415
Ohoopee River	Little Ohoopee River to US Hwy 292 (Emanuel/Candler/Tattnell Co.)	564	1192
Pendleton Creek	Sand Hill Creek to Reedy Creek (Treutlen Co.)	9	102
Pendleton Creek	Wildwood Lake to Tiger Creek (Treutlen/Toombs Co.)	9	200
Penholoway Creek	Little Creek to Altamaha River (Wayne Co.)	0	5014
Rocky Creek	GA Hwy 130 to Little Rocky Creek (Toombs Co.)	0	50
Rocky Creek	Little Rocky Creek to Ohoopee River (Toombs/ Tattnall Co.)	0	120

STREAM SEGMENT	LOCATION	WLA (lbs/day)	TMDL (lbs/day)
Sardis Creek	Headwaters to little Ohoopee River (Emanuel Co)	0	25
Swift Creek	Old Normantown Rd. to Pendleton Creek (Toombs Co.)	363	435
Ten Mile Creek	Little Ten Mile Creek to Altamaha River (Appling Co.)	0	2264
Thomas Creek	D/S CR203 to Ohoopee River (Tattnell Co)	0	31
Tiger Creek	Little Creek to Pendleton Creek (Montgomery/ Toombs Co.)	0	71
Yam Grandy Creek	D/S Crooked Creek (Emanuel Co.)	393	428

Monitoring: Follow-up monitoring according to 5-year River Basin Planning cycle (Georgia EPD, 1996)

Approach: NPDES Permits for point sources; Best management practices for nonpoint sources.

Date Submitted: Draft on June 30, 2001, Final in February 2002,
Draft in June 2006, Final in January 2007
Revised Draft in July 2021 .

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Historically assessed water bodies were placed into one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process and are published in 2000 and 2006 *Water Quality in Georgia* Reports (GA EPD, 2000 and GA EPD, 2006).

Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the constituent(s) in violation of the water quality standard. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and to restore and maintain water quality.

The State of Georgia identified twenty-eight (28) stream segments located in the Altamaha River Basin as water quality limited due to dissolved oxygen (DO). These waterbodies were included in the State's 2000 and 2006 303(d) lists. This revised report presents the DO TMDLs for the 28 listed segments in the Altamaha River Basin identified in Table E-1 and E-2.

1.2 Watershed Description

The Altamaha River Basin, as shown in Figure 1-1, is located in southeastern Georgia, encompassing approximately 2,440 square miles. The Ogeechee River Basin to the east and the Satilla River Basin to the west border the Altamaha River Basin. The Altamaha River is formed where the Ocmulgee River joins the Oconee River near the city of Hazelhurst. The Ohoopee River, which originates in Washington County, flows into the Altamaha River approximately 40 miles downstream of the confluence. The Altamaha River then flows in a southeastern direction to the Atlantic Ocean. The Altamaha River Basin contains parts of the Southeastern Plain and Southern Coastal Plain physiographic provinces, which extend throughout the southeastern United States.

The USGS has divided the Altamaha River Basin into two sub-basins, or Hydrologic Unit Codes (HUCs). Figure 1-2 shows the location of these sub-basins. Figure 1-3 shows the locations of the 8 listed DO segments in the Altamaha 8-digit HUC watershed (03070106) and Figure 1-4 shows the locations of the 20 listed DO segments in the Ohoopee 8-digit HUC watershed (03070107).

The land use characteristics of the Altamaha River Basin watersheds were determined using data from the National Land Cover Dataset (NLCD) for Georgia. This coverage is based on Landsat Thematic Mapper digital images developed in 2001. The classification is based on a modified Anderson level one and two system. Table 1-1 lists the land cover distribution and associated percent land cover.

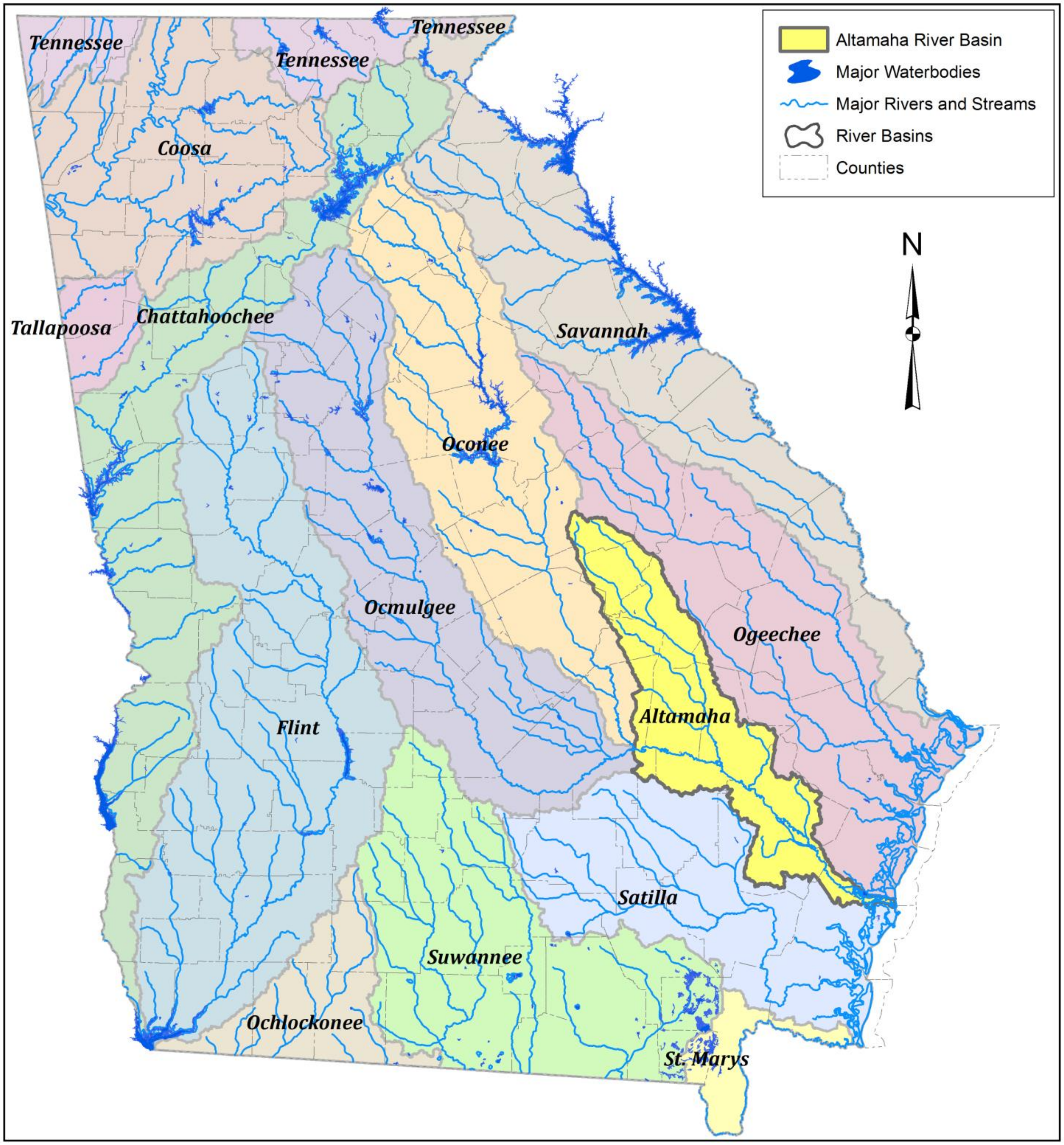

Figure 1-1. Location of the Altamaha River Basin in Georgia

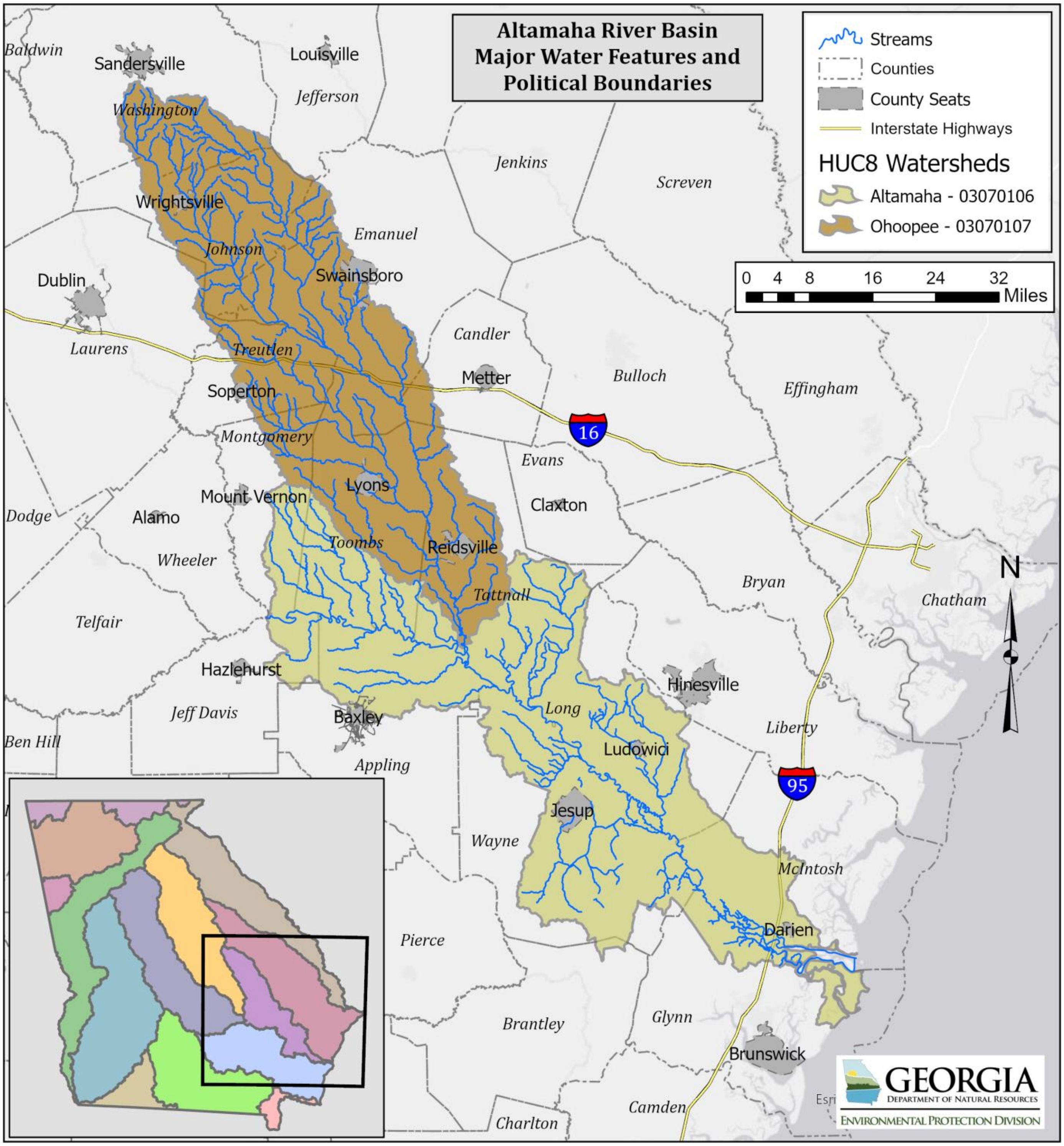

Figure 1-2. Major Water Features, USGS 8-Digit HUCs, and Political Boundaries

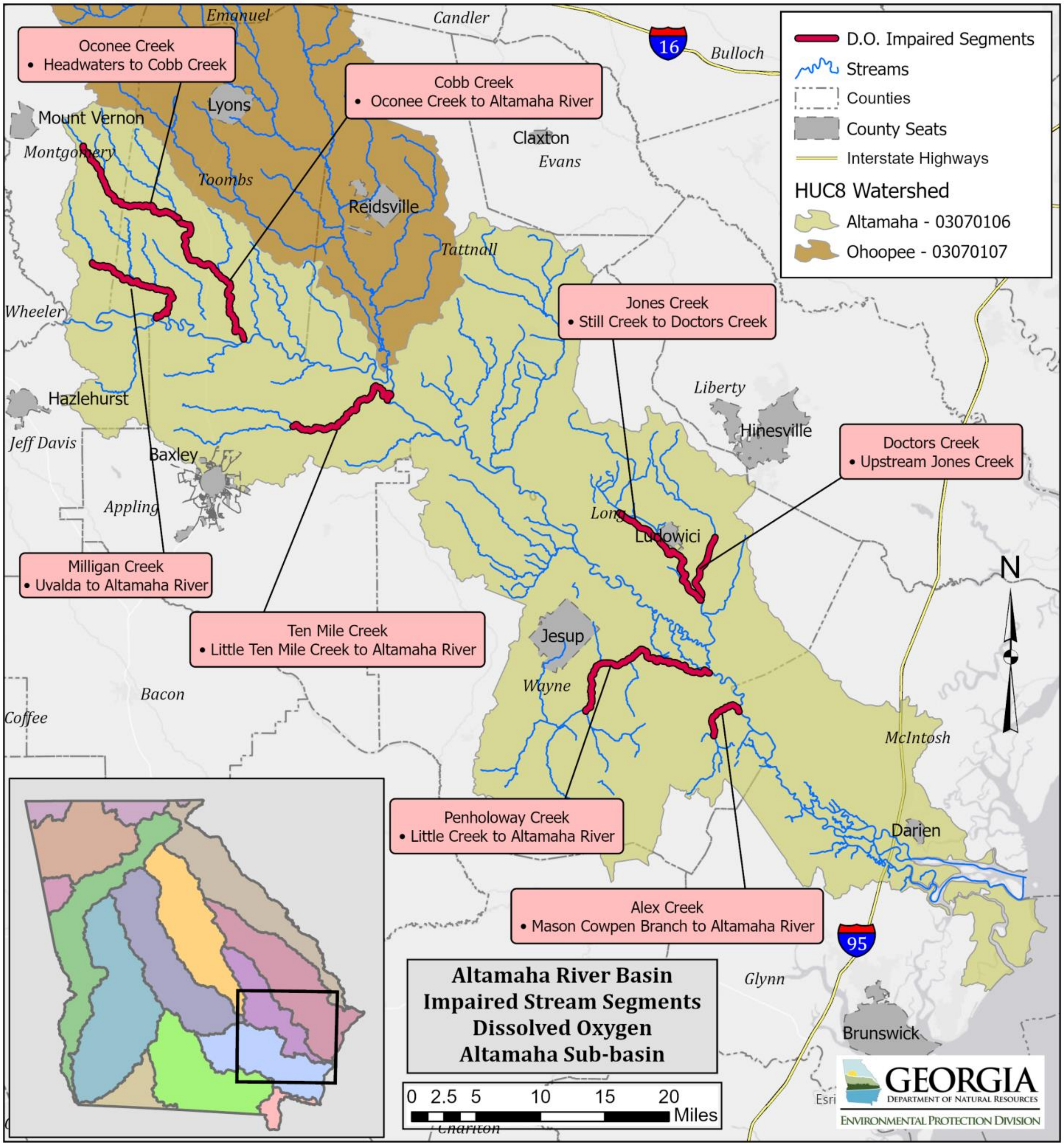

Figure 1-3. 303(d) Listed Segments for Dissolved Oxygen in the Altamaha 8-digit HUC within the Altamaha River Basin.

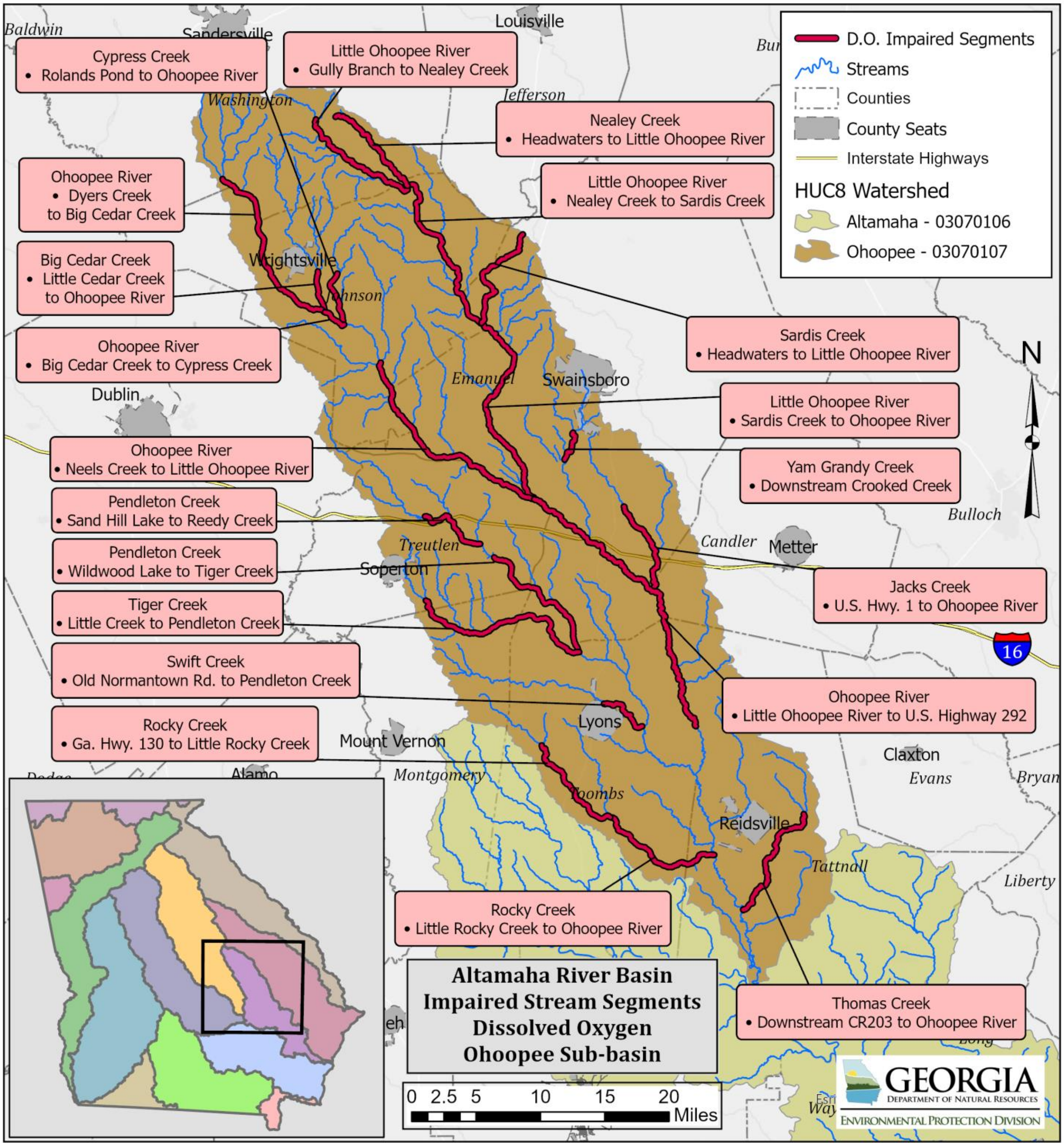

Figure 1-4. 303(d) Listed Segments for Dissolved Oxygen in the Ohoopee 8-digit HUC within the Altamaha River Basin.

Table 1-1. Land Uses Associated with Impaired Segments in the Altamaha River Basin.

Stream	Total Contributing Area (acres)	Cropland (%)	Pasture (%)	Forest (%)	Wetland (%)	Built-Up Impervious (%)	Built-Up Pervious (%)
Alex Creek	17,881	3.2	0.4	60.8	30.3	0.6	4.8
Big Cedar Creek	32,018	35.6	2.7	41.9	14.7	1.2	3.8
Cobb Creek	63,016	39.5	4.5	43.9	5.8	0.7	5.7
Cypress Creek	9,189	11.5	14.5	45.8	13.7	4.1	10.4
Doctors Creek	26,724	5.6	1.6	59.8	18.5	1.5	13.1
Jack's Creek	41,490	29.7	3.4	55.5	4.9	1.2	5.3
Jones Creek	72,646	4.2	0.8	55.5	31.5	1.0	7.0
Little Ohoopee River (Gully Branch to Nealey Creek)	29,414	26.4	2.0	47.3	18.5	0.6	5.2
Little Ohoopee River (Nealey Creek to Sardis Creek)	90,207	31.0	3.0	44.6	15.2	0.7	5.5
Little Ohoopee River (Sardis Creek to Ohoopee River)	159,209	27.5	2.9	49.7	11.8	0.8	7.3
Milligan Creek	28,703	41.4	4.5	39.7	4.9	1.1	8.4
Nealey Creek	6.4	6.1	65	9.7	2.4	10.3	6.4
Oconee Creek	19,456	34.4	3.9	49.5	5.3	0.7	6.1
Ohoopee River (Dyers Creek to Big Cedar Creek)	50,548	13.4	13.9	46.6	11.1	5	9.9
Ohoopee River (Big Cedar Creek) to Cypress Creek	11.1	11.1	50.7	12.8	5	9.2	11.1
Ohoopee River (Neels Creek to Little Ohoopee River)	189,360	29.4	4.5	49.3	10.8	0.8	5.1
Ohoopee River (Little Ohoopee River to US Hwy 292)	496,737	28.6	3.4	50.4	10.5	1.0	6.1
Pendleton Creek (Sand Hill Creek to Reedy Creek)	28,272	24.4	2.3	62.2	2.4	1.3	7.3
Pendleton Creek (Wildwood Lake to Tiger Creek)	68,959	25.5	3.4	57.0	4.6	1.4	8.0
Penholoway Creek	130,619	3.9	1.0	64.9	18.7	1.9	9.6
Rocky Creek (Little Rocky Creek to Ohoopee River)	55,825	37.7	5.4	42.6	5.6	2.1	6.6
Rocky Creek (GA Hwy 130 to Little Rocky Creek)	23,542	33.8	3.6	43.2	4.7	4.0	10.7
Swift Creek	35,662	35.7	7.2	41.3	7.1	1.9	6.7
Ten Mile Creek	61,817	24.7	3.6	56.9	6.1	1.0	7.6
Thomas Creek	27,695	31.9	2.8	51.9	4.0	1.3	8.0
Tiger Creek	43,049	31.4	6.1	49.3	5.4	1.0	6.7
Sardis Creek	12,761	14.5	10	53	3.8	3.6	15.1
Yam Grandy Creek	39,329	23.8	2.8	60.0	4.4	2.0	7.0

1.3 Water Quality Standards

All DO impaired waterbodies in the Altamaha River Basin have been assigned a water use classification of “Fishing.” Georgia’s water quality standards specify the following DO criteria for this use classification:

Numeric. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish*. A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resource Division. (*There are no designated trout streams in the Altamaha River Basin). .” 391-3-6-.03(6)(c)(i)

Georgia EPD, 2000

Certain waters of the state may have conditions where DO is naturally lower than the numeric criteria specified above and therefore cannot meet these standards unless naturally occurring loads are reduced or streams are artificially or mechanically aerated.

Natural Water Quality. “It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and best management practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.” 391-3-6-.03(7)

Georgia EPD, 2000

EPA Dissolved Oxygen Criteria were used to address these situations. Alternative EPA limits are defined as 90% of the naturally occurring DO concentration at critical conditions.

“Where natural conditions alone create dissolved oxygen concentrations less than 110 percent of the applicable criteria means or minima or both, the minimum acceptable concentration is 90 percent of the natural concentration.” Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Freshwater), EPA440/5-86-003, April 1986.
US EPA, 1986

Accordingly, if the naturally occurring DO exceeds GA EPD numeric limits at critical conditions then the GA EPD numeric limits apply. If naturally occurring DO is lower than the GA EPD numeric limits then 90% of the natural DO will become the minimum allowable target.

2.0 WATER QUALITY ASSESSMENT

During 1999, United States Geological Survey (USGS) collected water quality data in Georgia at a total of 214 stations. This including 187 in the Middle Three Basins (Altamaha, Ocmulgee, and Oconee) and 35 water quality stations in the Altamaha River Basin. Of the 35 stations monitored in the Altamaha River Basin, twenty three (23) had violations of the instream DO criteria. During 2004, the USGS collected water quality data at twenty eight (28) stations in the Altamaha River Basin; of these, five (5) stations had DO standard violations.

The data showed that DO impairments occurred exclusively during the summer months. Furthermore, all of the impairments were limited to small, headwater streams where the drainage areas are relatively small and dry weather flows are low, or zero. In the downstream reaches of larger watersheds where the streams not intermittent, flows are higher, and the assimilative capacity is greater, the DO concentrations always met the minimum standard of 4.0 mg/L and the daily average of 5.0 mg/L.

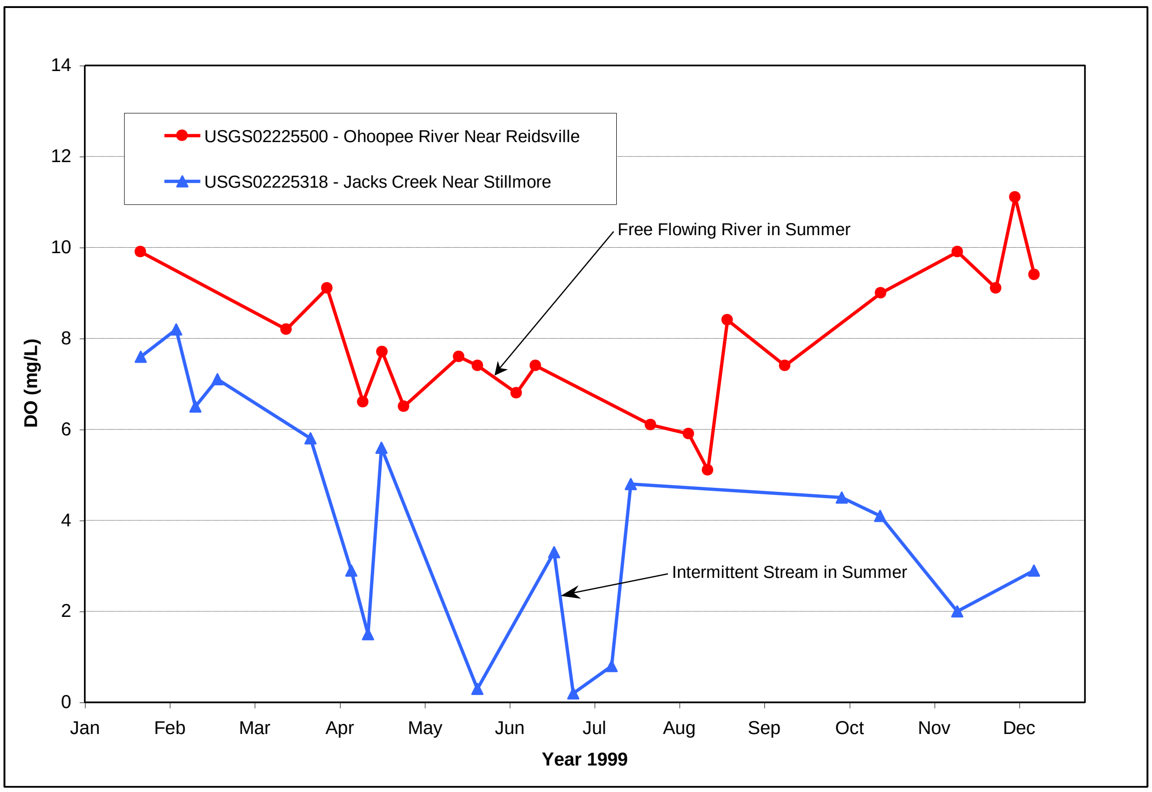

Figure 2-1. Comparison of Dissolved Oxygen Data at Two Ohoopee River Basin Locations.

Figure 2-1 illustrates this important finding by comparing measured DO levels in a non-intermittent, free-flowing stream to DO levels found in a small stream with low or no observable flow. The free flowing river data were collected at USGS 02225500 (GA EPD 06010001), which is located on the Ohoopee River at Reidsville near its confluence with the Altamaha River. This station also had historic trend data back to 1972, which showed no DO violations over the historic period of record. The other data in Figure 2-1 were collected at Jacks Creek near Stillmore, GA, a small headwater stream in the upper part of the Ohoopee River Basin. These two sets of data are representative of DO conditions observed at other stations in the basin.

GA EPD staff visited the Ohoopee River Basin on April 11, 2001, to observe stream characteristics such as velocities, depths, floodplain widths, riparian vegetation, and adjacent land use. These characteristics have a direct bearing on low DO concentrations. At all sampling stations visited on the Ohoopee River mainstem and its tributaries, the streams flowed through dense, forested swamps with forested stream buffers. All of the visited sites were similar in that the stream would flow out of the shaded forested swamp, which receives a significant amount leaf litterfall, into small clearings for bridges and road access. At each clearing, direct sunlight, small patches of aquatic plants, and heavily vegetated floodplains were observed. Figure 2-2 shows a sampling site on the Little Ohoopee River. Even though the site visit occurred during a period of higher flow, these essential characteristics are still apparent.

Figure 2-2. Picture of Sampling Site on Little Ohoopee River (SR56) Near Covena, GA.

Figure 2-3 shows the 2000 impaired segments for DO and the water quality stations that indicated each impairment. All 23 segments were listed as a direct result of the 1999 DO data. Typically, there are some historical 303(d) listings, but this was not the case for the Altamaha River Basin.

All field data relevant to the Middle Three Basins TMDLs were compiled by GA EPD and included in electronic database files. The data are managed in the Georgia envirOnmnetal Management and Assessment System (GOMAS), an electronic database developed by GA EPD that contain the historic water quality data.

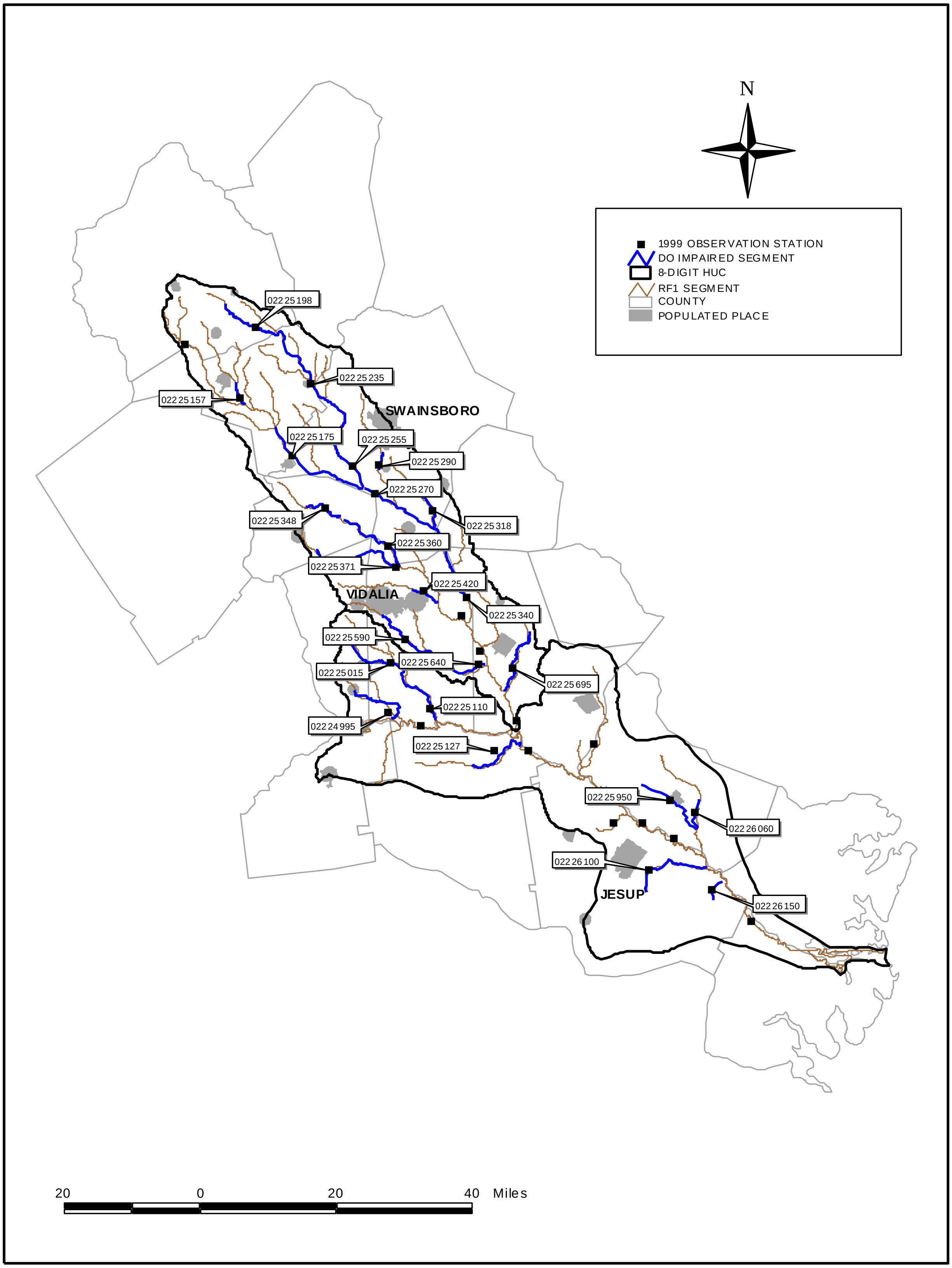

Figure 2-3. 1999 USGS Water Quality Stations in the Altamaha River Basin.

3.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of potential source categories. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of oxygen demanding substances on land surfaces that wash off as a result of storm events.

3.1 Point Source Assessment

Title IV of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permit program. Basically, there are two categories of NPDES permits: 1) municipal and industrial wastewater treatment facilities, and 2) regulated storm water discharges.

3.1.1 Wastewater Treatment Facilities

In general, industrial and municipal wastewater treatment facilities have NPDES permits with effluent limits. These permit limits are either based on federal and state effluent guidelines (technology-based limits) or water quality standards (water quality-based limits).

EPA has developed technology-based limits, which establish a minimum standard of pollution control for municipal and industrial discharges without regard for the quality of the receiving waters. These are based on Best Practical Control Technology Currently Available (BPT), Best Conventional Control Technology (BCT), and Best Available Technology Economically Achievable (BAT). The level of control required by each facility depends on the type of discharge and the pollutant.

EPA and the States have also developed numeric and narrative water quality standards. Typically, these standards are based on the results of aquatic toxicity tests and/or human health criteria and include a margin of safety. Water quality-based effluent limits are set to protect the receiving stream. These limits are based on water quality standards that have been established for a stream based on its intended use and the prescribed biological and chemical conditions that must be met to sustain that use.

Municipal and industrial wastewater treatment facilities' discharges may contribute oxygen-demanding substances to the receiving waters. As of 2021, there are sixteen NPDES permitted discharges with effluent limits for oxygen consuming substances identified in the Altamaha River Basin watershed. This includes six discharges classified as major discharges, with permit limits of 1.0 million gallons per day (MGD) or more, two industrial discharges, and one Confined Animal Feeding Operation (CAFO). Seven of the facilities do not discharge into or upstream of an impaired segment. At the time of the original impairments, there were three additional point sources that have either moved to another watershed or their permits have been terminated. Table 3-1 provides the eight point sources in the Ohoopee River Basin and two in the Altamaha River Basin that discharged into or upstream of an impaired segment at the time of the original DO impairments, the four new points source that have been permitted since 2007, and one facility that was converted from a general permit to an individual NPDES permit. Table 3-2 provides the permit limits at the time of the impairments. Figure 3-1 shows the location of each facility that remains a permitted NPDES discharge in 2021 relative to the impaired segments. Also included in Figure 3-1 are seven NPDES facilities that that do not discharge into or upstream of a DO impaired segment. These facilities were included in the TMDL DO model to ensure adequate water quality is maintained through NPDES permits throughout the Altamaha River Basin.

Combined sewer systems convey a mixture of raw sewage and storm water in the same conveyance structure to the wastewater treatment plant. These are considered a component of municipal wastewater treatment facilities. When the combined sewage and storm water exceed the capacity of the wastewater treatment plant, the excess is diverted to a combined sewage overflow (CSO) discharge point. There are no permitted CSO outfalls in the Altamaha River Basin.

Table 3-1. Contributing Point Sources in the Altamaha River Basin.

NPDES Permit Number	Facility Name	Receiving Water	8-Digit HUC	County
GA0034771	Cato's MHP Lyons[1]	Williams Creek	Altamaha	Toombs
GA0022900	Rogers State Prison WPCP	Ohoopee River	Ohoopee	Tattnall
GA0037338	Harrison WPCP[2]	Little Cedar Creek	Ohoopee	Washington
GA0031551	Johnson County LTC, LLC[3]	Unnamed Tributary to Pendleton Creek	Ohoopee	Johnson
GA0050231	L.G. Herndon Jr. Farms, Inc. [2]	Unnamed Tributary to Cobb Creek	Altamaha	Toombs
GA0049166	Ludowici WPCP	Jones Creek	Altamaha	Long
GA0033391	Lyons North WPCP	Swift Creek	Ohoopee	Toombs
GA0033405	Lyons East WPCP	Unnamed Tributary to Pendleton Creek	Ohoopee	Toombs
GA0050059	Santa Claus Pond[1]	Little Rocky Creek	Ohoopee	Toombs
GA0020346	Swainsboro Crooked Creek WPCP[1]	Crooked Creek	Ohoopee	Emanuel
GA0039225	Swainsboro Yam Grandy WPCP[2]	Yam Grandy Creek	Ohoopee	Emanuel
GA0049956	Tennille Pond[1]	Dyers Creek	Ohoopee	Washington
GA0025488	Vidalia WPCP	Swift Creek	Ohoopee	Toombs
GA0032395	Wrightsville Pond[4]	Unnamed Tributary to Big Cedar Creek	Ohoopee	Johnson
GA0050251	Wrightsville WPCP[2]	Ohoopee River	Ohoopee	Johnson

1 - Permits have been terminated
2 - New permits issued since 2007
3 - Previously covered under General Pemit GAPID1000
4 - Consent Order was issued in 2003 to terminate this facility

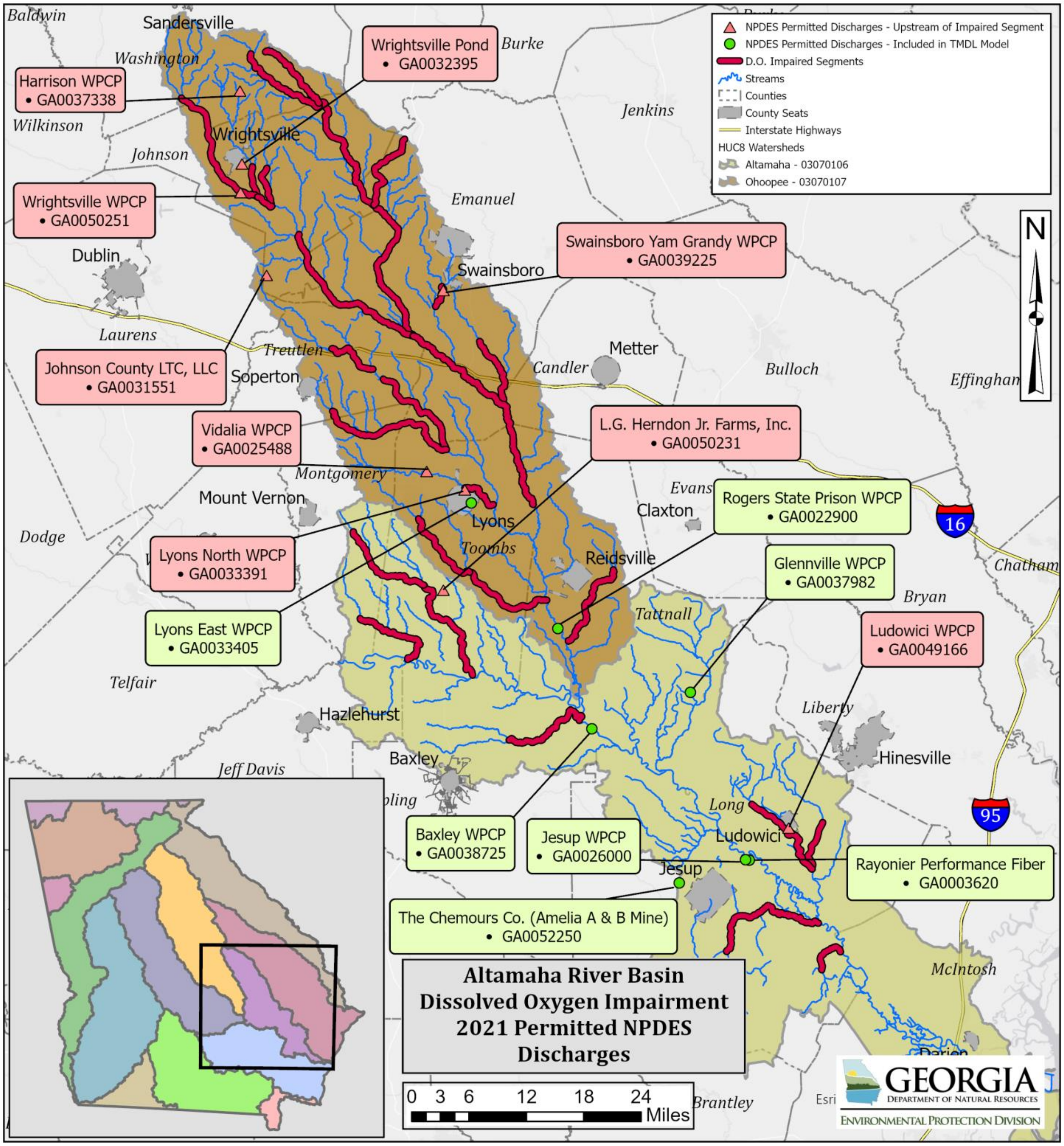

Figure 3-1. NPDES Point Sources in the Altamaha River Basin.

Table 3-2. 2003 NPDES Permit Limits in the Altamaha River Basin at the Time of the DO Impairments

Facility Name	NPDES Permit No.	Receiving Stream		NPDES Permit Limits				
				Flow (MGD)	BOD_5 (mg/L)	NH_3 (mg/L)	Minimum DO (mg/L)	Critical UOD (lbs/day)
Tennille Pond	GA0049956	Dyers Creek		0.45	15	1.1	6	151
DOC Rogers State Prison[1]	GA0026900	Ohoopee River		0.85	30	17.4	2	1095
Ludowici WPCP	GA0049166	Jones Creek		0.24	30	NL	5	309
Wrightsville Pond	GA0032395	Unnamed Tributary to Big Cedar Creek		0.745	30	17.4	5	960
Swainsboro Crooked Creek WPCP	GA0020346	Crooked Creek		3.0	30	17.4	2	3866
Santa Claus Pond	GA0050059	Rocky Creek		0.01	30	-	5	13
Lyons East WPCP[1]	GA0033405	Unnamed Tributary to Pendleton Creek	Jan – Apr	0.67	20	5	5	191
			May – Nov		10	2	5	
			Dec		20	5	5	
Lyons North WPCP	GA0033391	Swift Creek	Jan	0.67	20	5	5	191
			Feb - Mar		30	2	2	
			Apr		20	5	5	
			May		15	5	5	
			Jun		10	5	5	
			Jul - Sep		10	2	6	
			Oct		15	5	5	
			Nov		15	5	5	
			Dec		20	5	5	
Vidalia WTF	GA0025488	Swift Creek	Jan	1.88	20	5	5	535
			Feb		30	2	2	
			Mar		30	2	2	
			Apr		20	5	5	
			May		15	5	5	
			Jun - Oct		10	2	6	
			Nov		15	5	5	
			Dec		15	5	5	
Cato’s MHP Lyons	GA0034771	Williams Creek		0.013	30	NL		17
Johnson County LTC, LLC	GA0031551	UNT to Pendleton Creek		General Permit				9

Facility Name	NPDES Permit No.	Receiving Stream	NPDES Permit Limits				
			Flow (MGD)	**BOD_5 (mg/L)**	**NH_3 (mg/L)**	**Minimum DO (mg/L)**	**Critical UOD (lbs/day)**
Wrightsville WPCP	GA0050251	Ohoopee River	New Facility				
Swainsboro Yam Grandy Creek WPCP	GA0039225	Yam Grandy Creek	New Facility				
L.G. Herndon Jr. Farms, Inc.	GA0050231	Unnamed Tributary to Cobb Creek	New Facility				
Harrison WPCP	GA0037338	Little Cedar Creek	New Facility				

1 – Facility does not discharge to DO impaired segment, mistakenly included in 2002 and 2007 Altamaha DO TMDL reports.

3.1.2 Regulated Storm Water Discharges

Some storm water runoff is covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe limits, storm water NPDES permits establish controls “to the maximum extent practicable” (MEP). Regulated storm water discharges that may contain oxygen demanding substances consist of those associated with industrial activities, including construction sites one acre or greater, and large, medium, and small municipal separate storm sewer systems (MS4s) that serve populations of 50,000 or more and have an overall population density of at least 1,000 people per square mile.

Storm water discharges associated with industrial activities are currently covered under a General Storm Water NPDES Permit. This permit requires visual monitoring of storm water discharges, site inspections, implementation of BMPs, and record keeping.

Storm water discharges from MS4s are very diverse in pollutant loadings and frequency of discharge. At present, all cities and counties within the state of Georgia that had a population of greater than 100,000 at the time of the 1990 Census are permitted for their storm water discharge under Phase I. Each individual Phase I MS4 permit requires the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, as well as design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit. A program to monitor and control pollutants in storm water discharges from industrial facilities, construction sites, and highly visible pollutant sources that exist within the MS4 area must be implemented under the permit. Additionally, monitoring of not supporting streams, public education and involvement, post-construction storm water controls, low impact development, and annual reporting requirements must all be addressed by the permittee on an ongoing basis. There are no Phase I MS4s in the Altamaha River Basin.

As of March 10, 2003, small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. Seventy-three (73) municipalities, thirty-five (35) counties, five (5) Department of Defense facilities, and the Georgia Department of Transportation (GDOT) are permitted under the Phase II storm water regulations in Georgia. All municipal Phase II permittees are authorized to discharge under Storm Water General Permit GAG610000. Department of Defense facilities are authorized to discharge under Storm Water General Permit GAG480000. GDOT owned or operated facilities are authorized to discharge under Storm Water General Permit GAR041000. Under these general permits, each permittee must design and implement a SWMP that incorporates BMPs that focus on public education and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction storm water management, and pollution prevention in municipal operations. There are no counties or communities located in the Altamaha River Basin that are covered by the Phase II General Storm Water Permit.

3.1.3 Confined Animal Feeding Operations

Confined livestock and confined animal feeding operations (CAFOs) are characterized by high animal densities. This results in large quantities of fecal material being contained in a limited area. Processed agricultural manure from confined hog, dairy cattle, and select poultry operations is generally collected in lagoons. It is then applied to pastureland and cropland as a fertilizer during the growing season, at rates that often vary monthly. Runoff during storm events may carry surface residual containing oxygen demanding substances to nearby surface waters.

In 1990, the State of Georgia began registering CAFOs. Many of the CAFOs were issued land application or NPDES permits for treatment of wastewaters generated from their operations. The type of permit issued depends on the operation size (i.e., number of animal units). Table 3-3 presents the swine and non-swine (primarily dairies) CAFOs located in the Altamaha River Basin at the time of the original impairments that were registered or had land application permits**.**

Table 3-3. Registered CAFOs in the Altamaha River Basin

Name	County	Animal Type	Total No. of Animals	Permit No.
Clint Oliver Farms	Tattnall	Swine	2400	GAU700000
E & S Dairy	Wayne	Dairy		
Joe Kennedy Farm	Toombs	Beef cattle	500	GAU700000
Young Dairy	Washington	Dairy		

Sources: Permitting Compliance and Enforcement Program, GA EPD, 2004
GA Dept. of Agriculture, 2006

3.2 Nonpoint Source Assessments

In general, nonpoint sources cannot be identified as entering a waterbody through a discrete conveyance at a single location. Typical nonpoint sources of oxygen demanding substances come from materials being washed into the rivers and streams during storm events. In 1999 and 2004, many streams in the Altamaha River Basin were dry, or had ponded areas and stagnant pools. If these conditions existed during the monitoring period, the streams were not sampled. Due to the lack of rainfall typical during the summer of 1999 and 2004, stormwater did not contribute to significant wash off of materials into the streams. Constituents that may have washed off of land surfaces in previous months or years had either flushed out of the system along with the water column flow or settled out and became part of the stream channel bottom.

In this manner, historic wash off of settleable materials accumulates and exerts sediment oxygen demand (SOD). Constituents of concern from surface washoff include the fractions of NH_3 and BOD_5 that become an integral part of channel bottom sediments, thus becoming a potential source of SOD. Table 1-1 provides the land cover distributions for the listed Altamaha River watersheds. These data show that the watersheds are predominately forested, with approximately 52.2 percent (ranging from 45.8 to 65 percent) of forest land use. Agriculture is the next predominate land use, with approximately 11.4 percent row crops (ranging from 6.4 to 14.5 percent) and approximately 11.1 percent pasture (ranging from 6.1 to 14.5 percent). Approximately 9.5 percent (ranging from 8.9 to 14.9 percent) of the land use in these watersheds is woody wetlands. Urban land use makes up approximately 14.7 percent (ranging from 13.8 to 18.5 percent) of these watersheds.

In addition to nonpoint sources of SOD associated with land disturbing activities, most of the streams in the Altamaha River Basin receive significant natural contributions of oxygen demanding organic materials from local wetlands and forested stream corridors. The following sources of naturally occurring organic materials have been identified:

- Adjacent wetlands, swamps, and marshes with organically rich bottom sediments; and
- Direct leaf litterfall onto water surfaces and adjacent floodplains from overhanging trees and vegetation.

Leaf litterfall is a major contributor to the amount of dissolved organic matter in the stream water column and the amount of SOD being exerted. Many streams in southern Georgia are also referred to as “blackwater” streams because of highly colored humic substances leached from surrounding marshes and swamps. In addition, low DO in blackwater streams is very common in the summer months when the temperatures are high and the flows are low (Meyer, 1992). The oxygen demanding effects of leaf litterfall are reflected in two ways: 1) by lowering the DO saturation of water entering the channel from adjacent swampy areas caused by decaying vegetation; and 2) by increasing SOD associated with vegetation decaying on stream channel bottoms.

3.2.1 Land Application Systems

Many smaller communities use land application systems (LAS) for treatment of their sanitary wastewater. These facilities are required through LAS permits to treat all their wastewater by land application and are to be properly operated as non-discharging systems that contribute no runoff to nearby surface waters. However, runoff during storm events may carry surface residual containing oxygen demanding substances to nearby surface waters. Some of these facilities may also exceed the ground percolation rate when applying their wastewater, resulting in surface runoff. If not properly bermed, this runoff, which contains oxygen demanding substances, may discharge to nearby surface waters.

At the time of the original TMDLs were developed, data showed there were six permitted LAS facilities located in the Altamaha River Basin. In 2021, EPD data was used to verify LAS facility locations. One LAS facility, Screven WPCP (GAJ020140), was erroneously included in the 2007 Altamaha DO TMDL. This facility is located in the Satilla River Basin. Two permitted LAS facilities were erroneously omitted from the 2002 and 2007 Altamaha DO TMDLs. One LAS facility was permitted and began operating in an impaired stream watershed since the 2007 Altamaha DO TMDL document was developed. Table 3-4 has been updated to ensure accurate representation of permitted LAS facilities in the Altamaha River Basin.

Table 3-4. Permitted Land Application Systems in the Altamaha River Basin

LAS Name	County	Permit No.	Type	Impaired Stream Watershed	Flow (MGD)
Chicken of the Sea International [1]	Toombs	GAJ010452	Industrial	Swift Creek GAR030701070404	0.42
Crider Poultry Emanuel	Emanuel	GAJ010300	Industrial	Jacks Creek GAR030701070303	1.7
Reidsville - Sherwood Forest WPCP	Tattnall	GAJ020058	Municipal	N/A	0.5
DNR Gordonia-Altamaha State Park WPCP	Tattnall	GAJ020255	Municipal	N/A	0.18
Stillmore WPCP	Emanuel	GAJ020075	Municipal	Jacks Creek GAR030701070303	0.05
Swainsboro LAS – No longer in effect	Emanuel	GAJ020257	Municipal	Yam Grandy Creek GAR030701070305	1.86

LAS Name	County	Permit No.	Type	Impaired Stream Watershed	Flow (MGD)
Uvalda WPCP [2]	Montgomery	GAJ020040	Municipal	Milligan Creek GAR030701060101	0.15
Vidalia South WPCP [2]	Toombs	GAJ020100	Municipal	Rocky Creek GAR030701070505 / GAR030701070504	1.8

Original TMDL Source: Permitting Compliance and Enforcement Program, GA EPD, Atlanta, Georgia, 2006
Revised TMDL Source: Wastewater Regulatory Program, GA EPD, Atlanta, Georgia, 2021

1 – Permitted in 2011, not included in 2002 or 2007 Altamaha DO TMDLs
2 – Permitted prior to 1999, erroneously omitted from 2002 or 2007 Altamaha DO TMDLs
Note: Screven WPCP LAS (GAJ020140) was included in the 2007 Altamaha DO TMDL. However, it is located in the Satilla River Basin

3.2.2 Surface Washoff and Leaf Litter Decay

In 1999, many streams in the basin were dry or had ponded areas and stagnant pools as a result of a 3-year drought in Georgia. Due to the absence of rainfall during the summer months of 1999, the critical time period, stormwater did not contribute any washoff of materials into the streams. Any constituents that may have washed off of disturbed land surfaces in previous months or years have either: (1) already flushed out of the system along with the water column flow; or, (2) a portion may have settled out to become a part of the stream channel bottom.

In this same manner, the historic washoff of settleable material could accumulate and exert an additional sediment oxygen demand attributable to man's land disturbing activities. The constituents of concern from surface washoff include the fraction of ammonia and BOD5 that become an integral part of channel bottom sediments and thus become a potential source of sediment oxygen demand. Table 1-3 describes the land use distributions associated with each impaired stream. Note the relatively high percentages of forested and wetland land uses combined and the low percentages of built up areas. This land use distribution typified the Altamaha and Ohoopee Basins.

Most of the streams in the Altamaha Basin receive significant natural contributions of oxygen demanding organic materials from local wetlands and forested stream corridors, in addition to the aforementioned nonpoint sources of sediment oxygen demand associated with man's land disturbing activities. The following sources of naturally occurring organic materials have been identified:

- Adjacent wetlands and swamps with organically rich bottom sediments; and,
- Direct leaf litterfall onto water surfaces and adjacent floodplains from overhanging trees and vegetation.

Leaf litterfall is a major contributor to the amount of dissolved organic matter in the stream water column and the amount of sediment oxygen demand being exerted. Many streams in southern Georgia are also referred to as "blackwater" streams because of highly colored humic substances leached from surrounding marshes and swamps. In addition, low DO in blackwater streams is very common in the summer months when the temperatures are high and the flows are low (Meyer, 1992). The oxygen demanding effects of leaf litterfall were reflected here in two ways: (1) by lowering the DO saturation of water entering the channel from adjacent swampy areas caused by decaying vegetation; and (2) by increasing SOD associated with vegetation decaying on stream channel bottoms.

4.0 TECHNICAL APPROACH

The first step of the technical approach for these TMDLs was to select the models that can be effectively used to analyze the Altamaha River DO resources. After appropriate models are selected, data is gathered to develop and calibrate the models. The calibrated models are then used to establish the TMDL during critical conditions. The modeling approach is described in the following sections.

4.1 Model Selection and Structure

Various analyses were performed to correlate the measured low DO concentrations to basic causes such as point and nonpoint contributions, flow conditions, stream and watershed characteristics, seasonal temperature effects, and others. From these analyses, the low DO values were found to coincide with low or zero flows, slow stream velocities, shallow water depths, and high temperatures. Inflows of very low DO waters from adjacent marshes and forested swamps compounded the situation. Since the impairments noted in 1999 and 2004 occurred during sustained periods of low flows, a steady-state modeling approach was selected.

Georgia DOSAG is a one-dimensional steady state water quality model that was developed by the GA EPD. The model was selected for the following reasons:

- It conforms to GA EPD standard practices for developing wasteload allocations (WLAs);
- It works well for low flow and high temperature conditions;
- It can be developed with a limited dataset; and
- It is able to handle branching tributaries and both point and nonpoint source inputs.

Georgia DOSAG computes instream DO using an enhanced form of the Streeter-Phelps equation (Thomann and Mueller, 1987). The model applies the equation to each stream reach over small incremental distances. The model also provides a complete spatial view of a system, upstream to downstream. This allows the modeler to understand the important differences in stream behavior at various locations throughout a basin.

Georgia DOSAG consists of a mainstem and unlimited number of branches. However, the branches must be dendritic. Each branch must have an open upstream boundary not connected back to another branch. DOSAG can also include unlimited number of tributaries, water intakes, and low-head dams, as well as point sources. One DOSAG model was developed to represent the five listed segments in the Altamaha River Basin.

USGS quadrangle maps and navigational maps along with ArcView and MapInfo spatial graphics files were used to develop drainage areas, stream lengths, bed slopes, segment geometry, and other physical input data for each model. The DOSAG model structures is presented in Appendix A.

4.1.1 Calibration Data

The model calibration period was determined from an examination of the historic water quality data, for each station located on an impaired segment. The data were plotted and evaluated for streamflow, DO, water temperature, BOD5, and ammonia to determine a worst case for DO. The combination of the lowest, steady flow period with the lowest DO, and highest BOD concentrations, defined the critical modeling period. For all 28 of the impaired segments in this report, the 10^{th} percentile DO and critical low flow and high temperature were adopted as the critical conditions for model calibration. The average BOD5, and ammonia were also extracted from the dataset for each sampling station. BOD5 was converted to CBODU by multiplying by an f-ratio of 2.5 for municipal facilities and 4.5 for industrial facilities (standard GA EPD modeling practice) and ammonia was converted to NBODU by multiplying by the stoichiometric conversion factor of 4.57. These values, thusly determined, were incorporated into the DOSAG model calibration files.

4.1.2 SOD Representation

SOD is an important part of the oxygen budget in shallow streams. Because there were no field SOD measurements in the Middle Three Basins, the original 2002 Altamaha DO TMDLs used sediment oxygen demands (SODs) based in measurements taken in the South 4 Basin. In the South 4 Basins, the SOD measurements that ranged from 0.9 to 1.9 g/m^2/day. An examination of SOD results was performed. Results from all calibrated models of existing conditions were compiled and summarized and an average value of existing SOD was determined to be 1.35 g/m^2/day. This represented 12 models that had mixed land uses and varying degrees of point source activity. When the same 12 models were re-run under natural conditions assuming zero point source discharges and completely forested watersheds, SOD averages 1.25 g/m^2/day. These two values were adopted for the Altamaha River Basin to represent SOD for: (1) mixed land uses, including agriculture; and (2) natural or totally forested watersheds, respectively.

To calibrate the model, the bottom fractions in the single DOSAG model used to model the entire Altamaha River Basin were adjusted. The bottom fractions range from 0 to 1 with a median value of 0.4.

4.2 Calibration Model

Calibration inflows throughout the basin ranged from 0.0 to 20.2 cfs derived from daily flow records at various USGS gages. Productivity factors ranged from 0.02 to 0.42 cfs/mi^2 with a median value of 0.035 cfs/mi^2. Critical water temperatures were developed by examining the long-term trend monitoring data. Water temperature varied across the basin from 25 to 32 degrees Celsius based on the critical summer-time temperatures measured at various monitoring stations throughout the Basin. Average values of CBODU and NBODU and the 10th percentile of all the measured DO values were used as in-stream targets to calibrate the models. Headwater and tributary water quality boundaries were developed from in-stream field data, expected low DO saturation values (Meyer, 1992), and GA EPD standard modeling practices. SOD rates were set at 1.35 g/m^2/day to reflect mixed land uses. For the calibration model, the dischargers' CBOD and NBOD permitted loads at the time of the impairments (given Table 3-2) were input at half the permitted load by entering half the permitted flow into the model. Rayonier Performance Fibers was input at 54 MGD.

Figure 4-1 depicts a longitudinal DO calibration curve for the mainstem of the Ohoopee River developed using this approach. The Ohoopee River serves as a good illustrative example because it had more instream sampling stations than any other listed segment and thus can provide the best indication of the success to be expected from this modeling approach throughout a river system and

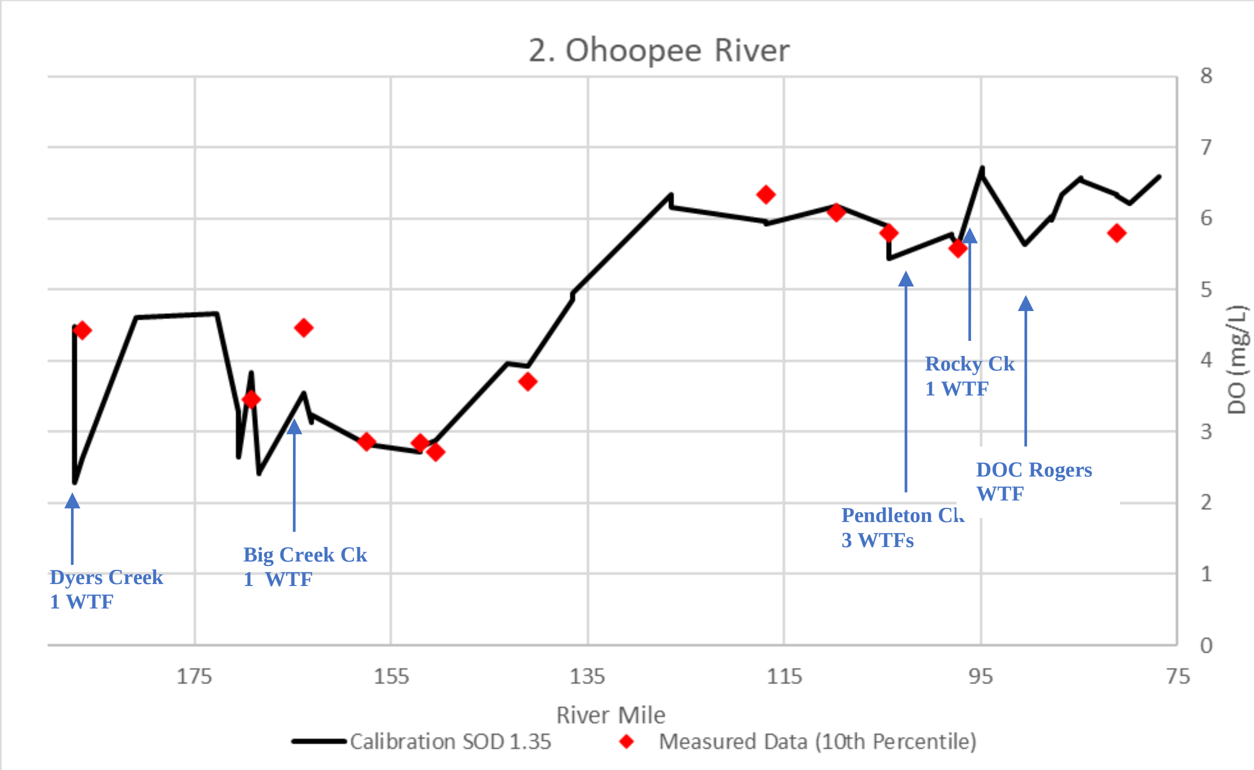

Figure 4-1. Dissolved Oxygen Calibration for the Ohoopee River.

for other river basins. Considering the scarcity of field data to work with and the fact that major portions of the Ohoopee River Basin had low or no observable flow, this calibration is viewed as exceptionally good. Accordingly, the DOSAG models developed for TMDL analysis can be viewed as dependable and instructive.

4.3 Critical Conditions Model

The critical conditions model was developed, in accordance with GA EPD standard practices, to assess DO standards, to determine if a problem exists requiring regulatory intervention, and to establish a level of protection if necessary. To do this, the calibrated model was modified in the following manner. Point sources were incorporated into the critical conditions models at their 2003 NPDES permit limits. Water quality boundaries and all other modeling rates and constants were the same as those in the calibrated models, including SOD = 1.35 g/m^2/day representing mixed land uses. To determine the effects of point sources alone, at critical conditions, a parallel set of model runs were made with point source flows set equal to zero.

4.4 Natural Conditions Model

For the natural conditions runs, two relevant changes were made to the critical conditions models. First, SOD was changed from 1.35 g/m^2/ day to 1.25 g/m^2/day to reflect the change from mixed land uses to natural or completely forested land uses. And second, all point source discharges were completely removed. All other model parameters remained the same, except the bottom fractions in the four upper segments of the Ohoopee River which were reduced from 1.0 to 0.7. These segments may have been affected by sludge from the Tennille discharge.

The results of the natural condition runs are plotted in Figure 4-2 along with the calibration and critical conditions model results for comparison. It's important to note: (1) even though DO was found to be low in the summer of 1999 the results are even lower at standard critical conditions; (2) June 1999 conditions are very close to natural conditions and compare favorably with the 90% of natural DO standard; and, (3) downstream of river mile 35-40 the critical DO rises above 5 mg/L indicating that the GA EPD numeric standard applies in that reach of the River and that a DO violation does not occur. DOSAG models for other impaired reaches can be used to develop similar insights.

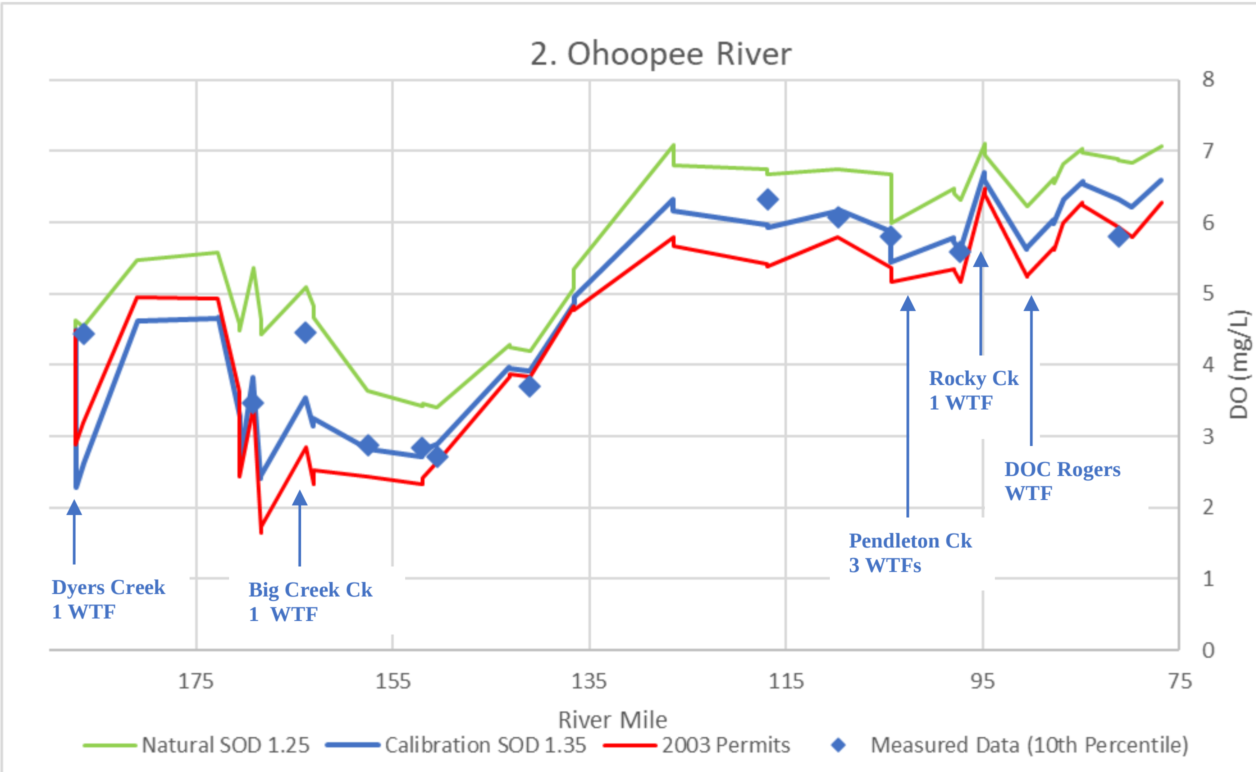

Figure 4-2. Natural Condition, Calibration, and Critical 2003 Permitted Ohoopee River Model Results

4.5 TMDL Model

The DO TMDLs allocations are based on EPA Dissolved Oxygen Criteria that states if the natural DO is less than the standard, then a 10% reduction in the natural condition is allowed. The target limits were defined as 90% of the naturally occurring DO concentration at critical conditions. The natural DO, target DO, and critical 2003 permit DO results for the Ohoopee River are plotted in Figure 4-3. Two conditions are apparent. First, upstream between river miles 136 and 187, the cause of oxygen deficits below the 90% of natural standard are two point sources, one on Dyers Creek and the other on Big Cedar Creek. Second, downstream between river miles 76 and 136 in the free flowing portion of the Ohoopee River, the effects of all point sources in the basin combined are small, and DO at critical conditions rises above the standard of 5 mg/L. Regulatory intervention is not required for the downstream free flowing stretches of the Ohoopee River; but regulatory intervention is required for the upstream segments where dry weather flows are low or zero and stream channels are dominated by the point source discharges.

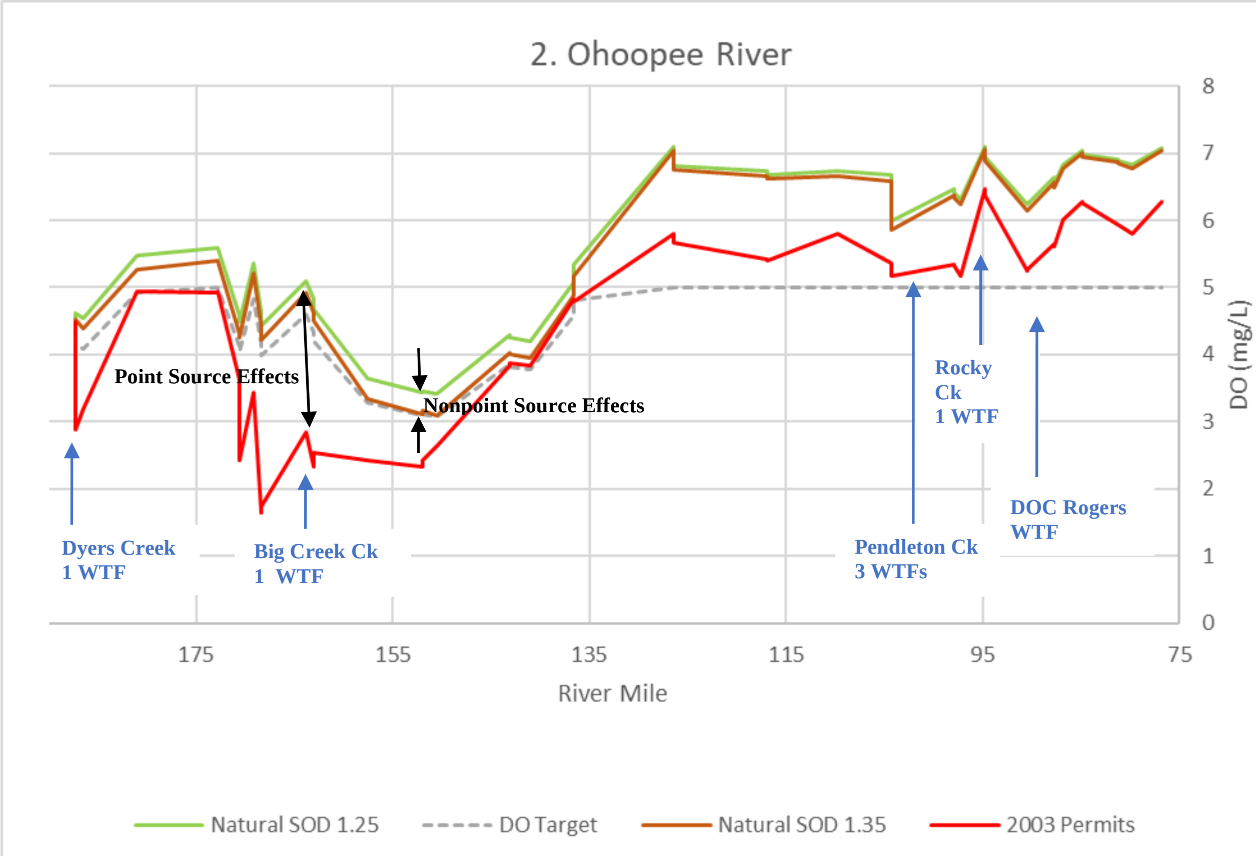

Figure 4-3. Natural, DO Target, Nonpoint Source, and Critical 2003 Permitted Ohoopee River Model Results.

Figure 4-3 also shows the influence of agricultural nonpoint sources. The plot includes the target DO concentration (equal to 90% of the natural conditions), natural run using an SOD of 1.25 g/m^2/day, a natural run using an SOD of 1.35 g/m^2/day that represents the nonpoint source contribution, and the 2003 critical permit run. This figure shows two other sets of model results: (1) both point and nonpoint sources; and (2) nonpoint sources alone. The nonpoint source model run (Natural SOD 1.35 g/m^2/day) shows DO above the natural DO target line for all of the Ohoopee River. From this, the agriculture nonpoint source by itself does not exceed the 10% of natural limit and therefore does not require any reductions.

The TMDL model was used to determine what reductions need to occur to meet the natural DO target. For the Ohoopee River Basin, two point source loads needed to be removed and several point source loads needed to be reduced in the Ohoopee River branches. Figure 4-4 is a plot of the natural, natural DO target, critical 2003 permit, and TMDL model results.

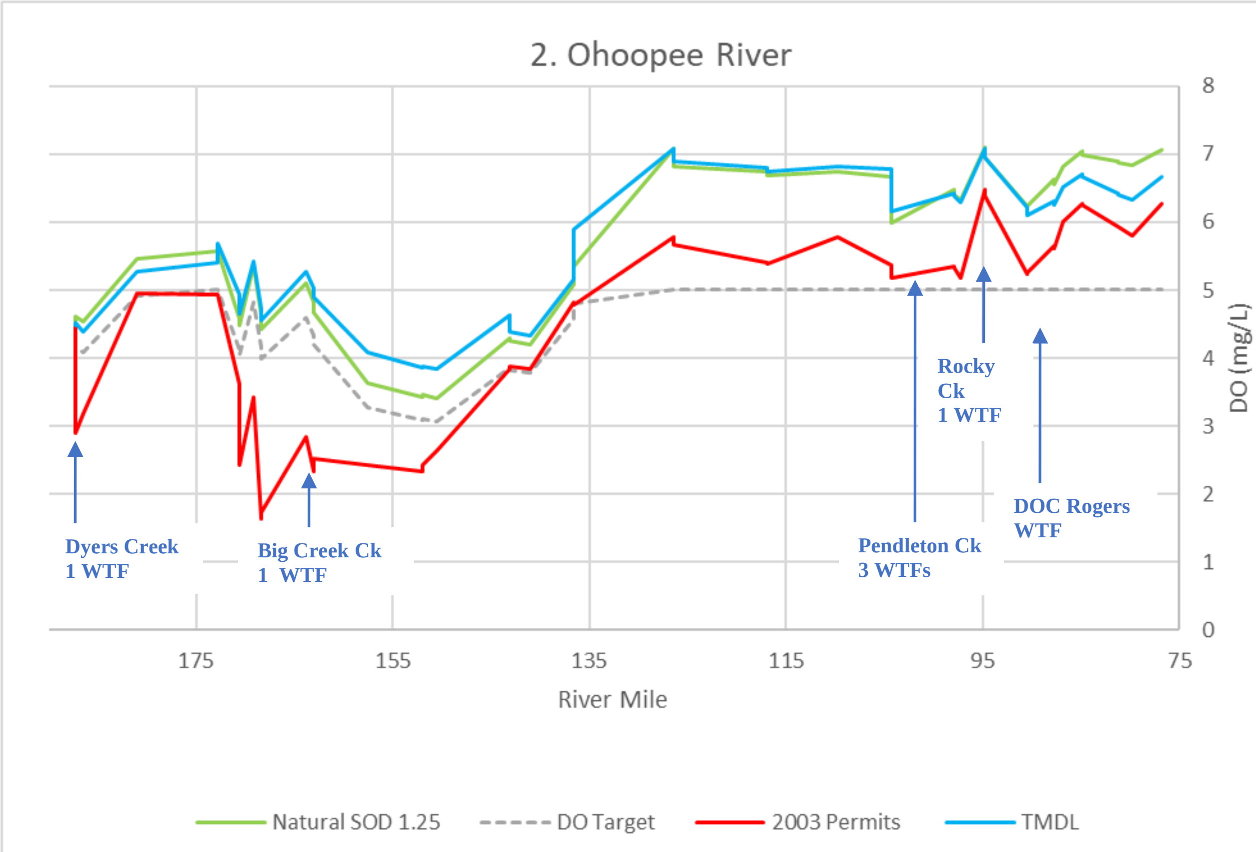

Figure 4-4. Natural, DO Target, Critical 2003 Permitted and TMDL Ohoopee River Model Results.

Figure 4-5 represents a different type of allocation scenario where the watershed is impaired for DO but does not contain any point sources. The plots in Figure 4-5 are from the Little Ohoopee River where agriculture, which comprises 30% of the watershed, makes up the anthropogenic nonpoint source load. The level of agricultural contribution is typical for many of the impacted segments in the basin. The results show that the DO at critical conditions, reflecting the full effect of agricultural activities, is near the target DO of 90% of natural conditions. Therefore, no load reductions would be necessary in this watershed because nonpoint contributions do not consume more than 10% of the naturally occurring DO.

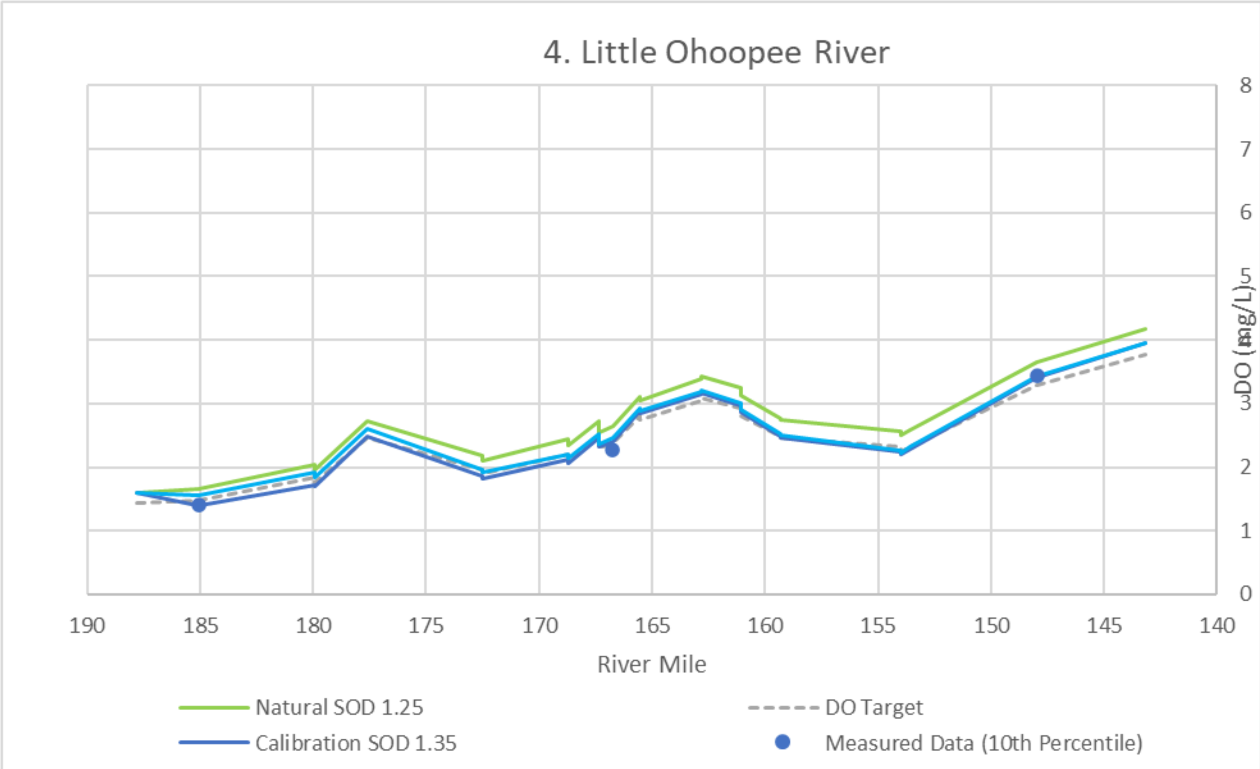

Figure 4-4. Critical Conditions and 90% of Natural Conditions for a Watershed without Point Sources (Little Ohoopee River).

5.0 TOTAL MAXIMUM DAILY LOAD

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard. A TMDL is the sum of the individual waste load allocations (WLAs) from point sources and load allocations (LAs) from nonpoint sources, as well as the natural background (40 CFR 130.2) for a given waterbody. The TMDL must also include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the water quality response of the receiving water body (USEPA, 1991). TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures. For oxygen demanding substances, this TMDL is expressed in pounds per day (lbs/day).

Conceptually, a TMDL can be expressed as follows:

$$\textbf{TMDL} = \Sigma\ \textbf{WLAs} + \Sigma\ \textbf{LAs} + \textbf{MOS}$$

This TMDL determines the allowable oxygen demanding loads to the listed segments in the Altamaha River Basin. The following sections describe the various oxygen demanding sources, which may contribute loads to the TMDL components.

The first step in the TMDL development process was to determine naturally occurring DO concentrations for the impaired waterbodies. By doing so, the applicable water quality standard used for TMDL development can be identified.

To determine naturally occurring DO concentrations, the steady-state DOSAG models were run at critical conditions, with zero point source inputs and nonpoint source inputs representing forested or wetland conditions free from man's influences. According to EPA Dissolved Oxygen Criteria, the target limits were identified as 90% of the naturally occurring concentration.

After identifying the DO target limits, the models were run at critical conditions to determine the loading capacity of the waterbody. This was accomplished through a series of simulations aimed at meeting the DO target limit by varying source contributions. The final acceptable scenario represented the TMDL (and loading capacity of the waterbody).

5.1 Wasteload Allocations

The waste load allocation (WLA) is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems, as well as permitted storm water discharges. There are ten existing NPDES permitted facilities covered by these TMDLs.

The TMDL model, described in Section 4, was used to determine the WLAs needed to meet the DO standards. Allocations are based on the EPA Dissolved Oxygen Criteria, which states that if the natural DO is less than the standard (5.0 mg/L) then a 10 percent reduction in the natural condition is allowed. The target DO limits are defined as 90 percent of the naturally occurring DO concentration at critical conditions. Appendix B contains plots of the DO concentrations resulting from the TMDL loads versus the target DO Standard. Note that if the TMDL plot is higher than the target DO Standard plot, there is additional assimilative capacity in the stream available for future WLAs. If a future WLA should use this additional assimilative capacity, EPD will amend this TMDL document with an addendum that will be public noticed.

The WLAs include 'Direct' and 'Upstream' contributions. The 'Direct' loads are the point source loads discharging directly into the impaired stream segment. The 'Upstream' load is one that discharges in an upstream segment that is transported downstream to the impaired segment. The DO results account for in-stream, kinetic processes that would occur from the discharge point to the upstream boundary of the impaired segment.

Based on the 2002 TMDL modeling, two facilities in the Ohoopee River Basin needed to be eliminated: Tennille WPCP (GA0049956) and the Wrightsville Pond WPCP (GA0032395). Two other point source loads in the Pendleton Creek Basin were also identified as needing to have their loading reduced: Vidalia WPCP (GA0025488) and Lyons North WPCP (GA0033391). The 2007 TMDL modeling supported the need for the relocation of the Wrightsville Pond.

In 2021, there are nine existing NPDES permitted facilities in the Altamaha River watershed that effect instream DO. The Santa Claus (GA0050059) and Cato's MHP Lyons (GA0034771) permits have been terminated. The Tennille discharge has been relocated from Dyers Creek in the Altamaha River Basin to Buffalo Creek in the Oconee River Basin. Swainsboro eliminated their GA0020346 discharge to Crooked Creek and relocated their discharge to Yam Grandy Creek permitted under GA0039225. The City of Wrightsville has been under a consent order since 2003 to eliminate the GA0032395 discharge and a new Wrightsville WPCP permit (GA0050251) has been issued to discharge directly to the Ohoopee River. Since 2007, new permits have been issued for Harrison (GA0037338) to discharge to Little Cedar Creek and LG Herndon Jr Farms (GA0050231) to discharge to an unnamed tributary to Cobb Creek, and the Johnson County - Scott Health WPCP, which had a general NPDES permit, has been issued an individual NPDES permit (GA0031551) to discharge to an unnamed tributary to Pendleton Creek.

Table 5-1 provides the WLAs and permit limits necessary to meet the natural DO target. In addition, WLAs are provided for the other discharges included in the TMDL model that do not discharge to or are upstream of a DO impaired stream segment: Department of Corrections (DOC) Rogers State Prison (GA0022900), Lyons East WPCP (GA0033405), Chemours Co - Amelia A & B Mine (GA0050250), Baxley WPCP (GA0038725), Glennville WPCP (GA0037982), Jesup WPCP (GA0026000), and Rayonier Performance Fibers (GA0003620). Permit limits for some of these facilities have been revised to meet instream ammonia and DO criteria.

The TMDL and TMDL model will be used to assess permit renewals. If necessary, GA EPD may modify the WLAs during the NPDES permitting process. The assimilative capacity might not be fully allocated for all of the listed segments. Future WLAs might be allowed if the discharge does not result in a concentration lower than 90 percent of the natural DO concentration during critical conditions. However, it should be noted that the SOD rates used in the TMDL allocation models were based on predictions and may need to be verified before WLAs are implemented.

When a WLA predicts the critical DO concentrations to be less 3.0 mg/L, the biological integrity of the stream will need to be evaluated. The biological evaluation should include a habitat assessment, aquatic macroinvertebrate community assessment, fish community assessment, and in-situ physical and chemical measurements. The most updated Standard Operating Procedures (SOP) should be used for the macroinvertebrate and fish assessments.

State and Federal Rules define storm water discharges covered by NPDES permits as point sources. However, storm water discharges are from diffuse sources and there are multiple storm

Table 5-1. WLA for NPDES Permit Limits for Contributing Point Sources

NPDES Permit No.	NPDES Permit	Receiving Stream	Season	Flow (MGD)	BOD5 (mg/L)	NH3 (mg/L)	DO (mg/L)	Critical UOD (lbs/day)
Point Sources Contributing to Segments Impaired for DO								
GA0037338	Harrison WPCP	Little Cedar Creek	May-Oct	0.065	15	3.5	6	29
			Nov-Apr	0.065	30	10	5	
GA0031551	Johnson County LTC, LLC	Unnamed Tributary to Pendleton Creek		0.0067	30	17.4	3	9
GA0049166	Ludowici WPCP	Jones Creek		0.24	17.5	3	6	115
GA0050231	L.G. Herndon Jr. Farms, Inc.	Unnamed Tributary to Cobb Creek			250 lbs/day	145 lbs/day	5	1,289
GA0033391	Lyons North WPCP	Swift Creek	Jan	0.67	10	6.5	5	95
			Feb-Mar	0.67	15	8.7	2	
			Apr	0.67	10	3.5	5	
			May	0.67	7.5	2	5	
			Jun	0.67	5	1	5	
			Jul-Sep	0.67	5	1	6	
			Oct	0.67	7.5	1.5	5	
			Nov	0.67	7.5	2.5	5	
			Dec	0.67	10	5	5	
GA0039225	Swainsboro Yam Grandy Creek WPCP	Yam Grandy Creek		3	5	0.7	6	393
GA0025488	Vidalia WPCP	Swift Creek	Jan-Apr	1.88	7.5	2	6	268
			May-Oct	1.88	5	1	6	
			Nov-Dec	1.88	7.5	2	6	
GA0050251	Wrightsville WPCP	Ohoopee River		1	5	1	6	142
GA0032395	Wrightsville Pond WPCP	Unnamed Tributary to Big Cedar Creek		Consent Order to stop discharge				0 (960)
GA0034771	Cato's MHP Lyons	Williams Creek		Permit Terminated				0 (17)
GA0050059	Santa Claus Pond	Little Rocky Creek		Permit Terminated				0 (13)
GA0020346	Swainsboro Crooked Creek WPCP	Crooked Creek		Permit Terminated				0 (3,866)
GA0049956	Tennille Pond	Dyers Creek		Permit Terminated - Relocated				0 (151)
Permitted Point Sources Included in the TMDL Model that Do Not Contribute to Segments Impaired for DO								
GA0022900	Rogers State Prison WPCP	Ohoopee River		0.85	30	17.4	2	
GA0033405	Lyons East WPCP	Unnamed Tributary to Pendleton Creek	Jan-Apr	0.67	20	1.2	5	
			May-Nov	0.67	10	0.6	5	
			Dec	0.67	20	1.2	5	
GA0038725	Baxley WPCP	Altamaha River		2.8	30	17.4	2	

NPDES Permit No.	NPDES Permit	Receiving Stream	Season	Flow (MGD)	BOD5 (mg/L)	NH3 (mg/L)	DO (mg/L)	Critical UOD (lbs/day)
GA0050250	The Chemours Company (Amelia A & B Mine)	Millikin Bay		Report	Report	0.4		
GA0037982	Glennville WPCP	Unnamed Tributary to Spring Branch	May-Oct	2	5	0.5	6	
			Nov-Apr	2	12	0.7	5	
GA0026000	Jesup WPCP	Altamaha River		2.5	30	17.4	2	
GA0003620	Rayonier Performance Fibers (Outfalls 001 & 002)	Altamaha River	May-Nov	70	18650 lbs/day	1.5	2	
			Dec-Apr	70	32000 lbs/day	1.5	2	

water outfalls. Storm water sources (point and nonpoint) are different than traditional NPDES permitted sources in four respects: 1) they do not produce a continuous (pollutant loading) discharge; 2) their pollutant loading depends on the intensity, duration, and frequency of rainfall events, over which the permittee has no control; 3) the activities contributing to the pollutant loading may include the various allowable activities of others, and control of these activities are not solely within the discretion of the permittee; and 4) they do not incorporate wastewater treatment plants that control specific pollutants to meet numeric limits.

The intent of storm water NPDES permits is not to treat the water after collection, but to reduce the exposure of storm water to pollutants by implementing various controls. It would be infeasible and prohibitively expensive to control pollutant discharges from each storm water outfall. Therefore, storm water NPDES permits require the establishment of controls or BMPs to reduce pollutants entering the environment.

The Georgia DOSAG model was run under critical conditions, assuming 7Q10 flows and dry weather conditions. Because the critical conditions occur when there are no storm events, no numeric allocation is given to the waste load allocations from storm water discharges associated with MS4s (WLAsw).

5.2 Load Allocations

The nonpoint source loads for the existing LA and TMDL were computed from the model boundary conditions, which include the stream, tributary, and headwater model boundaries under critical conditions. The partitioning of allocations between point (WLA) and nonpoint (LA) sources shown in Table 5-2 is based on modeling results and professional judgment.

5.3 Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. Since impairments occurred only during critical summer months, and not during other times of year, a seasonal variation in the TMDL was neither necessary nor appropriate.

The low flow, high temperature critical conditions incorporated in this TMDL are assumed to represent the most critical design conditions and to provide year-round protection of water quality. These TMDLs are expressed as a total daily load during the critical low flow period. Table 5-1 provides seasonal permit limits and the total daily load during the critical low flow period.

5.4 Margin of Safety

The MOS is a required component of TMDL development. As specified by section 303(d) of the CWA, the margin of safety must account for any lack of knowledge concerning the relationship between effluent limitations and water quality. There are two basic methods for incorporating the MOS: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations, or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations.

For this TMDL, the MOS was implicitly incorporated in the use of the following conservative modeling assumptions:

- Critical 7Q10 streamflows;
- Hot summer temperatures, based on the historical record;

- DO saturation, for all flows entering the system, equal to those measured during the low DO period in the summer;
- Shallow water depths, generally less than one foot, which aggravates the effect of SOD;
- Slow water velocities, generally 0.5 fps or less, which intensifies the effect of BOD decay;
- Conservative reaction rates; and
- All point sources discharge continuously at their NPDES Permit limits for the same critical period.

Table 5-2. Existing and TMDL UOD Loads for Impaired Segments in the Altamaha River Basin.

Stream	Assessment Unit ID	Critical (2003)			TMDL				% TMDL Reduction
		Direct & Upstream WLA (lbs/day)	LA (lbs/day)	Total Load (lbs/day)	WLA (lbs/day)	WLAsw (lbs/day)	LA (lbs/day)	TMDL (lbs/day)	
Alex Creek	GAR030701060503	0	719	719	0	0	719	719	0
Big Cedar Creek	GAR030701070102	960	49	1009	29	0	49	78	92.3
Cobb Creek	GAR030701060102	0	1193	1193	1289	0	1193	2482	0
Cypress Creek	GAR030701070104	0	44	44	0	0	44	44	0
Doctors Creek	GAR030701060405	0	36	36	0	0	36	36	0
Jacks Creek	GAR030701070303	0	47	47	0	0	47	47	0
Jones Creek	GAR030701060404	309	61	370	115	0	61	176	52.4
Little Ohoopee River (Gully Branch to Nealey Creek)	GAR030701070201	0	38	38	0	0	38	38	0
Little Ohoopee River (Nealey Creek to Sardis Creek)	GAR030701070202	0	120	120	0	0	120	120	0
Little Ohoopee River (Sardis Creek to Ohoopee River)	GAR030701070203	0	212	212	0	0	212	212	0
Milligan Creek	GAR030701060101	0	542	542	0	0	542	542	0
Nealey Creek	GAR030701070206	0	12	12	0	0	12	12	0
Oconee Creek	GAR030701060103	0	364	364	0	0	364	364	0
Ohoopee River (Dyers Creek to Big Cedar Creek)	GAR030701070101	151	61	212	142	0	61	203	4.2
Ohoopee River (Big Cedar Creek to Cypress Creek)	GAR030701070106	1111	112	1223	171	0	112	283	76.9
Ohoopee River (Neels Creek to Little Ohoopee River)	GAR030701070103	1111	244	1355	171	0	244	415	69.4
Ohoopee River (Little Ohoopee River to US Hwy 292)	GAR030701070304	4977	628	5605	564	0	628	1192	78.7
Pendleton Creek (Sand Hill Creek to Reedy Creek)	GAR030701070401	9	93	102	9	0	93	102	0
Pendleton Creek (Wildwood Lake to Tiger Creek)	GAR030701070402	9	191	200	9	0	191	200	0
Penholoway Creek	GAR030701060403	0	5014	5014	0	0	5014	5014	0
Rocky Creek (GA Hwy 130 to Little Rocky Creek)	GAR030701070505	0	50	50	0	0	50	50	0

Stream	Assessment Unit ID	Critical (2003)			TMDL				% TMDL Reduction
		Direct & Upstream WLA (lbs/day)	LA (lbs/day)	Total Load (lbs/day)	WLA (lbs/day)	WLAsw (lbs/day)	LA (lbs/day)	TMDL (lbs/day)	
Rocky Creek (Little Rocky Creek to Ohoopee River)	GAR030701070504	13	120	133	0	0	120	120	9.8
Sardis Creek	GAR030701070207	0	25	25	0	0	25	25	0
Swift Creek	GAR030701070404	726	72	798	363	0	72	435	45.5
Ten Mile Creek	GAR030701060201	0	2264	2264	0	0	2264	2264	0
Thomas Creek	GAR030701070506	0	31	31	0	0	31	31	0
Tiger Creek	GAR030701070403	0	71	71	0	0	71	71	0
Yam Grandy Creek	GAR030701070305	3866	35	3901	393	0	35	428	89.0

6.0 RECOMMENDATIONS

6.1 Monitoring Plan

The GA EPD has adopted a basin approach to water quality management; an approach that divides Georgia's major river basins into five groups. Each year, the GA EPD water quality monitoring resources are concentrated in one of the basin groups. One goal is to continue to monitor 303(d) listed waters. This monitoring will occur in the next monitoring cycle for the Altamaha in 2004 and will help further characterize water quality conditions resulting from the implementation of best management practices in the watershed.

6.2 Reasonable Assurance

The GA EPD is responsible for administering and enforcing laws to protect the waters of the State. Reasonable assurance ensures that a TMDL's wasteload and load allocations are properly distributed to meet the applicable water quality standards. Without such distribution, a TMDL's ability to serve as an effective guidepost for water quality improvement is significantly diminished. Federal regulations implementing the CWA require that effluent limits in permits be consistent with "the assumptions and requirements of any available [WLA]" in an approved TMDL [40 CFR 122.44(d)(1)(vii)(B)]. NPDES point source permits will be given effluent limits in the permit consistent with the individual WLAs specified in the TMDL.

The GA EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities that have a bearing on nonpoint source pollution include establishing water quality standards and use classifications, assessing and reporting water quality conditions, and regulating land use activities that may affect water quality. Georgia is working with local governments, agricultural, and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission, to foster the implementation of BMPs that address nonpoint source pollution. In addition, public education efforts are being targeted to individual stakeholders to provide information regarding the use of BMPs to protect water quality using both point and nonpoint source approaches.

6.3 Public Participation

A thirty-day public notice will be provided for this TMDL. During this time, the availability of the TMDL will be public noticed, a copy of the TMDL will be provided as requested, and the public will be invited to provide comments on the TMDL.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. EPD and EPA have executed a Memorandum of Understanding that documents the schedule for developing the more comprehensive plans. This Initial TMDL Implementation Plan includes a list of best management practices and provides for an initial implementation demonstration project to address one of the major sources of pollutants identified in this TMDL while State and/or local agencies work with local stakeholders to develop a revised TMDL implementation plan. It also includes a process whereby EPD and/or Regional Development Centers (RDCs) or other EPD contractors (hereinafter, "EPD Contractors") will develop expanded plans (hereinafter, "Revised TMDL Implementation Plans").

This Initial TMDL Implementation Plan, written by EPD and for which EPD and/or the EPD Contractor are responsible, contains the following elements.

1. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some best management practices. The "Management Measure Selector Table shown below identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any WLAs in this TMDL will be implemented in the form of water-quality based effluent limitations in NPDES permits issued under CWA Section 402. See 40 C.F.R. § 122.44(d)(1)(vii)(B). NPDES permit discharges are a secondary source of excessive pollutant loading, where they are a factor, in most cases.

2. EPD and the EPD Contractor will select and implement one or more best management practice (BMP) demonstration projects for each River Basin. The purpose of the demonstration projects will be to evaluate by River Basin and pollutant parameter the site-specific effectiveness of one or more of the BMPs chosen. EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major category of contribution of the pollutant(s) of concern for the respective River Basin as identified in the TMDLs of the watersheds in the River Basin. The demonstration project need not be of a large scale and may consist of one or more measures from the Table or equivalent BMP measures proposed by the EPD Contractor and approved by EPD. Other such measures may include those found in EPA's "Best Management Practices Handbook", the "NRCS National Handbook of Conservation Practices, or any similar reference, or measures that the volunteers, etc., devise that EPD approves. If for any reason the EPD Contractor does not complete the BMP demonstration project, EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan the EPD brochure entitled "Watershed Wisdom -- Georgia's TMDL Program" will be distributed by EPD to the EPD Contractor for use with appropriate stakeholders for this TMDL, and a copy of the video of that same title will be provided to the EPD Contractor for its use in making presentations to appropriate stakeholders, on TMDL Implementation plan development.

4. If for any reason an EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, EPD will be responsible for getting that (those) element(s) completed, either directly or through another contractor.

5. The deadline for development of a Revised TMDL Implementation Plan, is the end of August 2003.

6. The EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with EPD, will work on the following tasks involved in converting the Initial TMDL Implementation Plan to a Revised TMDL Implementation Plan:
   A. Generally, characterize the watershed;
   B. Identify stakeholders;
   C. Verify the present problem to the extent feasible and appropriate, (e.g., local monitoring);
   D. Identify probable sources of pollutant(s);
   E. For the purpose of assisting in the implementation of the load allocations of this TMDL, identify potential regulatory or voluntary actions to control pollutant(s) from the relevant nonpoint sources;
   F. Determine measurable milestones of progress;
   G. Develop monitoring plan, taking into account available resources, to measure effectiveness; and
   H. Complete and submit to EPD the Revised TMDL Implementation Plan.

7. The public will be provided an opportunity to participate in the development of the Revised TMDL Implementation Plan and to comment on it before it is finalized.

8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan when the Revised TMDL Implementation Plan is approved by EPD.

Management Measure Selector Table

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
Agriculture	1. Sediment & Erosion Control	_	_		_	_				
	2. Confined Animal Facilities	_	_							
	3. Nutrient Management	_	_							
	4. Pesticide Management		_							
	5. Livestock Grazing	_	_		_	_				
	6. Irrigation		_		_	_				
Forestry	1. Preharvest Planning				_	_				
	2. Streamside Management Areas	_	_		_	_				
	3. Road Construction &Reconstruction		_		_	_				
	4. Road Management		_		_	_				
	5. Timber Harvesting		_		_	_				
	6. Site Preparation & Forest Regeneration		_		_	_				
	7. Fire Management	_	_	_	_	_				
	8. Revegetation of Disturbed Areas	_	_	_	_	_				
	9. Forest Chemical Management		_			_				
	10. Wetlands Forest Management	_	_	_		_		_		

Land Use	**Management Measures**	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
Urban	1. New Development	–	–		–	–			–	
	2. Watershed Protection & Site Development	–	–		–	–		–	–	
	3. Construction Site Erosion and Sediment Control		–		–	–				
	4. Construction Site Chemical Control		–							
	5. Existing Developments	–	–		–	–			–	
	6. Residential and Commercial Pollution Prevention	–	–							
Onsite Wastewater	1. New Onsite Wastewater Disposal Systems	–	–							
	2. Operating Existing Onsite Wastewater Disposal Systems	–	–							
Roads, Highways and Bridges	1. Siting New Roads, Highways & Bridges	–	–		–	–			–	
	2. Construction Projects for Roads, Highways and Bridges		–		–	–				
	3. Construction Site Chemical Control for Roads, Highways and Bridges		–							
	4. Operation and Maintenance-Roads, Highways and Bridges	–	–			–			–	

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APPENDIX A

DOSAG TMDL MODEL STRUCTURE

Reach No.	Reach Name	Reach Type	River Mile	Elevation ft msl	Drainage Area (sq miles)
	Branch 1: ALTAMAHA RIVER				11,434
1	Confluence of Oconee/Ocmulgee Rivers to USGS 02224940	Stream	116.33	84.3	7.06
2	USGS 02224940 to Milligan Creek/Bullard Creek	Stream	114.54	83.1	26.31
3	Milligan Creek	Tributary	103.8	73.9	45.16
4	Bullard Creek	Tributary	103.8	73.9	41.16
5	Milligan Creek/Bullard Creek to USGS 02225000	Stream	103.8	73.9	8.75
6	**Proposed Lyons Discharge #2 (2012)**	Discharge	96.69	**67.7**	
7	USGS 02225000 to GA Power-Hatch Intake	Stream	96.69	67.7	0.84
8	GA Power Hatch Intake	Intake	95.93	67.1	
9	GA Power Hatch Intake to GA Power Hatch WPCP	Stream	95.93	67.1	0.27
10	**GA Power Nuclear Plant (GA0004120)**	Discharge	95.68	**66.9**	
11	GA Power Hatch WPCP to Cobb Creek	Stream	95.68	66.9	34.17
12	Junction Cobb Creek (Branch 18)	Branch Jct	94.33	65.9	
13	Cobb Creek to Inman Creek	Stream	94.33	65.9	28.4
14	Inman Creek	Tributary	86.29	60	16.8
15	Inman Creek to Ohoopee River	Stream	86.29	60	48.09
16	Junction Ohoopee River (Branch 2)	Branch Jct	76.83	55.4	
17	Ohoopee River to Tenmile Creek	Stream	76.83	55.4	3.36
18	Tenmile Creek	Tributary	72.09	53.1	97.1
19	Tenmile Creek to USGS 02225810	Stream	72.09	53.1	5.75
20	**Baxley WPCP (GA0038725)**	Discharge	70.37	**52.3**	
21	USGS 02225810 to Five Mile Creek	Stream	70.37	52.3	8.88
22	Five Mile Creek	Tributary	66.9	50.6	24.62
23	Five Mile Creek to Watermelon Creek	Stream	66.9	50.6	3.79
24	Watermelon Creek to Beards Creek	Tributary	64.04	48.2	49.5
25	Watermelon Creek to Beards Creek	Stream	64.04	48.2	7.54
26	Spring Branch-Beards Creek (Branch 10)	Branch Jct	58.57	42.5	
27	Beards Creek to Goose Creek	Stream	58.57	42.5	20.08
28	Goose Creek	Tributary	46.25	35.7	77.88
29	Goose Creek to USGS 02225990	Stream	46.25	35.7	6.76
30	USGS 02225990 to Rayonier Outfall 1	Stream	42.72	33.5	1.39
31	**Rayonier Outfall 1 (GA0003620)**	Discharge	41.53	**32.6**	
32	Rayonier Outfall 1 to Jesup WPCP/USGS 02226000	Stream	41.53	32.6	0.14
33	**Jesup WPCP (GA0026000)**	Discharge	41.21	**32.3**	
34	Jesup WPCP/USGS 02226000 to Rayonier Outfall 2	Stream	41.21	32.3	4.31
35	**Rayonier Outfall 2 (GA0003620)**	Discharge	40.66	**31.9**	
36	Rayonier Outfall 2 to USGS 02226010	Stream	40.66	31.9	14.04
37	USGS 02226010 to Penholoway Creek	Stream	33.4	26.8	22.51
38	Penholoway Creek	Tributary	21.28	15.2	215.05
39	Penholoway Creek to Doctors Creek	Stream	21.28	15.2	3.8
40	Junction Jones Creek/Doctor Creek (Branch)	Branch Jct	17.76	12.9	
41	Doctors Creek to Alex Creek	Stream	17.76	12.9	7.1
42	Alex Creek	Tributary	14.56	10.3	30.83
43	Alex Creek to USGS 02226160	Stream	14.56	10.3	27.92
44	USGS 02226160 to Stud Horse Creek (above Wesley Horn)	Stream	5.06	4.9	16
EOM	End Model		0		
	Branch 2: Ohoopee River				24.4
45	Junction Dyers Creek (Branch 12)	Branch Jct	187.23	335.4	
46	Dyers Creek to USGS 02225143 (Harts Ford Road)	Stream	187.23	335.4	1.06
47	USGS 02225143 (Harts Ford Road) to CR 89	Stream	186.43	331.3	15.64
48	CR 89 to Proposed Wrightsville Discharge	Stream	180.98	296.2	25.03
49	**Wrightsville Discharge**	Discharge	172.76	253	
50	Wrightsville Discharge to Big Cedar Creek	Stream	172.76	253	2.1
51	Junction Big Cedar Creek (Branch 3)	Branch Jct	170.54	247.9	
52	Big Cedar Creek to USGS 02225163 (Dude Sumner Rd)	Stream	170.54	247.9	1.56
53	USGS 02225163 (Dude Sumner Rd) to Cypress Creek	Stream	169.22	242.3	0.63

Reach No.	Reach Name	Reach Type	River Mile	Elevation ft msl	Drainage Area (sq miles)
54	Junction Cypress Creek (Branch 15)	Branch Jct	168.44	241.5	
55	Cypress Creek to Pullens Bridge Rd (USGS 02225165)	Stream	168.44	241.5	11.69
56	USGS 02225165 (Pullens Bridge Rd) to Neels/Randall Creek	Stream	163.85	222.3	1.64
57	Neels Creek	Tributary	163.08	220.5	19.11
58	Randall Creek	Tributary	163.08	220.5	23.52
59	Neels/Randall Creek to US 80 (USGS 02225170)	Stream	163.08	220.5	30.21
60	USGS 02225175 (US 80) to Mulepen Creek	Stream	157.51	201.3	23.23
61	Mulepen Creek	Tributary	151.97	188.4	20.86
62	Mulepen Creek to US 221 (USGS 02225190)	Stream	151.97	188.4	0.94
63	USGS 02225190 (US 221) to Little Ohoopee River	Stream	150.52	183.6	20.45
64	Junction Little Ohoopee River (Branch 4)	Branch Jct	143.14	164.2	
65	Little Ohoopee River to USGS 02225270 (GA297)	Stream	143.14	164.2	4.82
66	USGS 02225270 (GA297) to Yam Grandy Creek	Stream	141.04	160.4	14.07
67	Junction Yam Grandy Creek (Branch 5)	Branch Jct	136.54	151.5	
68	**Proposed Alt Location for I-16 Ind Park WPCP**	Discharge	136.54	151.5	
69	I-16 Ind Park Discharge to Jacks Creek	Stream	136.54	151.5	15.45
70	Jacks Creek	Tributary	126.45	136.3	65.39
71	Jacks Creek to Beaver Creek/EPD0607030402	Stream	126.45	136.3	23.65
72	Beaver Creek	Tributary	116.89	118.2	15.13
73	Beaver Creek/EPD0607030402 to USGS 02225340 (GA292)	Stream	116.89	118.2	22.39
74	**Proposed Lyons Discharge #1 (2012)**	Discharge	109.71	101.8	
75	USGS 02225340 (GA292) to Pendleton Creek	Stream	109.71	101.8	10.42
76	Junction Pendleton Creek (Branch 7)	Branch Jct	104.32	92.2	
77	Pendleton Creek to Brazells Creek	Stream	104.32	92.2	14.5
78	Brazells Creek	Tributary	97.93	91.4	31.92
79	Brazells Creek to USGS 02225500 (GA56)	Stream	97.93	91.4	0.87
80	USGS 02225500 (GA56) to Rocky Creek	Stream	97.29	91.4	17.5
81	Junction Rocky Creek (Branch 6)	Branch Jct	94.79	81.3	
82	Rocky Creek to DOC Rogers St Prison WPCP	Stream	94.79	81.3	10.85
83	**DOC Rogers State Prison WPCP (GA0022900)**	Discharge	90.51	81.1	
84	DOC Rogers St Prison WPCP to Thomas Creek	Stream	90.51	81.1	3.44
85	Thomas Creek	Tributary	87.78	75.3	43.69
86	Thomas Creek to Critical Habitat Unit	Stream	87.78	75.3	0.46
87	Critical Habitat Unit (Starting Point)	Stream	86.79	71.6	2.73
88	Battle Creek	Tributary	84.85	66.1	30.11
89	Battle Creek to Four Acre Tributary	Stream	84.85	66.1	2.78
90	Four Acre Creek	Tributary	81.21	61.6	9.27
91	Four Acre Creek to USGS 02225755 (GA 178)	Stream	81.21	61.6	2.98
92	USGS 02225755 (GA178) to Altamaha River	Stream	79.78	61	1.69
EOB	End Branch		76.83		
	Branch 3: Big Cedar Creek				11.37
93	Junction Little Cedar Creek (Branch 17)	Branch Jct	180.22	296	
94	Little Cedar Creek 1 to Little Cedar Creek 2	Stream	180.22	296	8.91
95	Little Cedar Creek (2)	Tributary	174.07	263.9	15.31
96	**Proposed Wrightsville Discharge 2008**	Discharge	174.07	263.9	
97	Little Cedar Creek(2) to Tributary	Stream	174.07	263.9	0.24
98	Junction Unnamed Tributary to Big Cedar Creek (Branch 11)	Branch Jct	173.78	262.9	
99	UNT to Contour 250ft	Stream	173.78	262.9	3.04
100	Contour 250ft to USGS02225157/Liberty Church Rd	Stream	172.11	253.5	0.72
101	USGS 02225157/Liberty Church Rd to Ohoopee River	Stream	171.63	252.7	0.61
EOB	End Branch		170.54		
	Branch 4: Little Ohoopee River				30.89
102	Golden Creek to USGS Gage 02225198	Stream	187.81	307.2	4.55
103	USGS 02225198 to Nealy Creek	Stream	185.07	293.2	10.59
104	Nealy Creek	Tributary	179.93	273.2	13.33
105	Nealy Creek to Gage 02225200	Stream	179.93	273.2	4.65
106	Gage 02225200 to Smith Creek	Stream	177.61	263.2	11.29

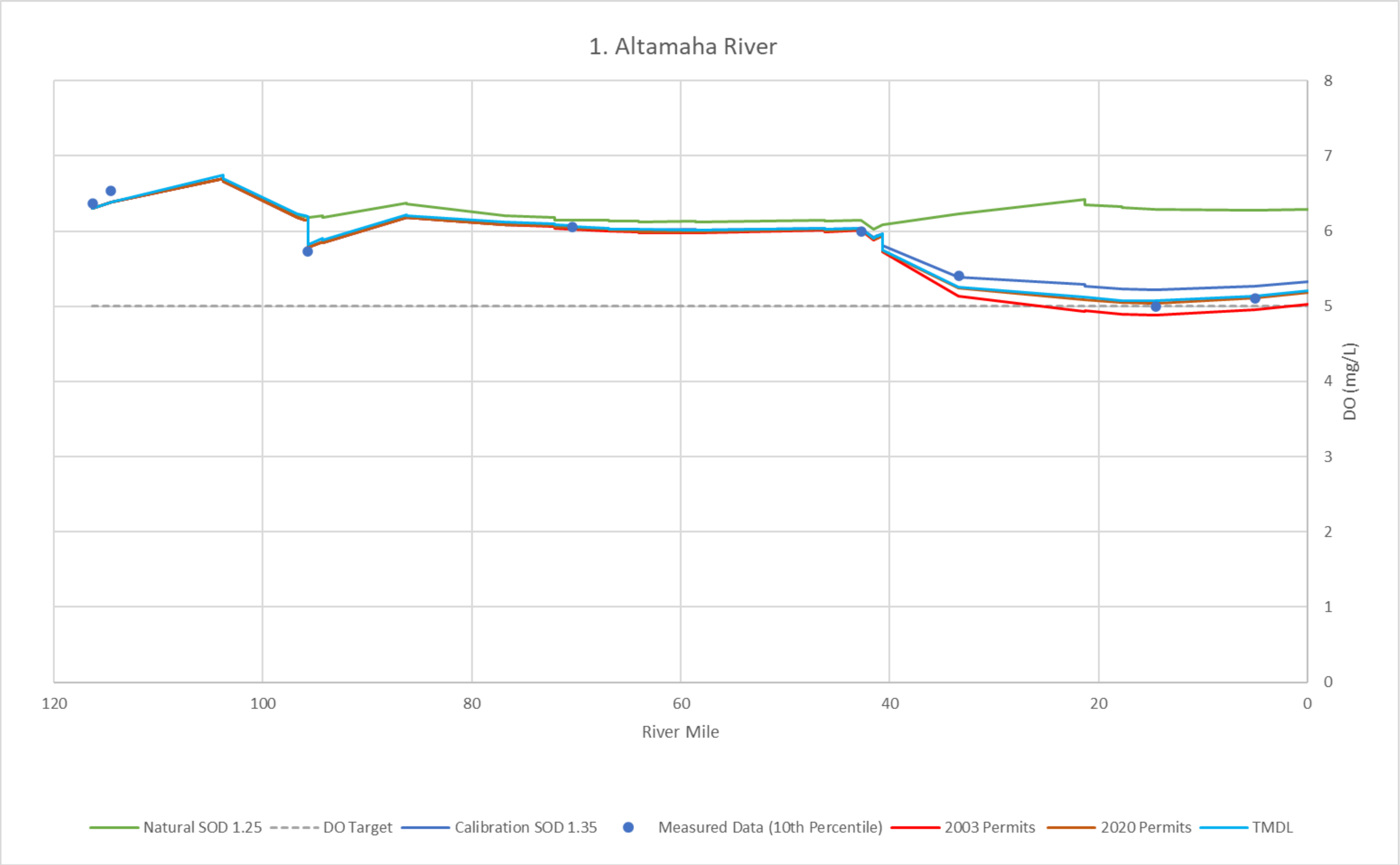
Reach No.	Reach Name	Reach Type	River Mile	Elevation ft msl	Drainage Area (sq miles)
107	Smith Creek Tributary	Tributary	172.51	247.2	12.35
108	Smith Creek to Swain Creek	Stream	172.51	247.2	2.54
109	Swain Creek	Tributary	168.72	235.2	10.69
110	Swain Creek to Battleground Creek	Stream	168.72	235.2	1.04
111	Battleground Creek	Tributary	167.37	230.2	19.87
112	Battleground Ck to Gage 02225235 (GA57)	Stream	167.37	230.2	0.26
113	Gage 02225235 (GA57) to Magruda Creek	Stream	166.73	228.2	8.52
114	Magruda Creek	Tributary	165.54	223.2	5
115	Magruda Creek to Sardis Creek	Stream	165.54	223.2	6.31
116	Junction Sardis Creek (Branch 16)	Branch Jct	162.84	214.2	
117	Sardis Creek to Crooked Creek	Stream	162.84	214.2	2.49
118	Crooked Creek	Tributary	161.09	210.2	14.14
119	Crooked Creek to Flat Creek 1	Stream	161.09	210.2	1.76
120	Flat Creek (1)	Tributary	159.31	207.2	5.94
121	Flat Creek(1) to Flat Creek(2)	Stream	159.31	207.2	17.63
122	Flat Creek (2)	Tributary	154	192.2	17.59
123	Flat Creek(2) to Gage 02225250 (Hwy 80)	Stream	154	192.2	1.62
124	Gage 02225250 Hwy 80 to Gage 02225255 GA 56	Stream	153.56	191.2	16.96
125	Gage 02225255 (GA56) to Ohoopee River	Stream	147.97	176.2	9.49
EOB	End Branch		143.14		
	Branch 5: Crooked Creek/Yam Grandy Creek				31.8
126	**New Swainsboro WPCP (GA0039225)**	Discharge	147.54	192	
127	Crooked Creek/New Swainsboro WPCP to USGS 02225290 (CR 198)	Stream	147.54	192	5.49
128	USGS 02225290 (CR 198) to Open Creek	Stream	144.71	187.6	1.07
129	Open Creek Tributary	Tributary	144.1	179.1	7.09
130	Open Creek to GA HWY 297 (USGS 022225291)	Stream	144.1	179.1	1.14
131	**Proposed I-16 Ind Park WPCP**	Discharge	143.15	178.9	
132	Proposed I-16 Ind Park Discharge to Ohoopee River	Stream	143.15	178.9	15.54
EOB	End Branch		136.54		
	Branch 6: Little Rocky Creek/Rocky Creek				6.51
133	**Santa Claus WPCP (<0.1 MGD) - Permit Rescinded**	Discharge	110.79	182.3	
134	Santa Claus WPCP to Little Rocky Creek	Stream	110.79	182.3	11.2
135	Little Rocky Creek	Tributary	106.45	130.3	37.2
136	Little Rocky Creek to Gage 02225600 (GA 147)	Stream	106.45	130.3	20.08
137	Gage 02225600 (Gage 147) to Gage 02225640 (CR 180)	Stream	100.01	102.3	12.05
138	Gage 02225640 (CR 180) to Ohoopee River	Stream	95.69	86.3	1.05
EOB	End Branch		94.79		
	Branch 7: Pendleton Creek				0.015
139	**Johnson County - Scott Health WPCP (GA0031551)**	Discharge	159.39	352.4	
140	WPCP to Pendleton Creek HW	Stream	159.39	352.4	0.44
141	Pendleton Creek HW	Tributary	158.86	325.7	
142	UNT to GA Hwy 86	Stream	158.86	325.7	2
143	GA Hwy 86 to GA Hwy 15/78	Stream	157.12	300.4	13.99
144	GA Hwy 15/78 to Alligator Creek	Stream	150.82	252.3	5.54
145	Alligator Creek	Tributary	147.71	234.2	5.89
146	Alligator Creek to Gage 02225348	Stream	147.71	234.2	17.59
147	Gage 02225348 to Wildwood Dam	Stream	141.75	206.5	25.05
148	Wildwood Dam to Long Creek	Stream	136.78	191.2	8.67
149	Long Creek Tributary	Tributary	131.49	170.9	8.86
150	Long Creek to Mill Creek	Stream	131.49	170.9	1.76
151	Mill Creek Tributary	Tributary	129.25	162.2	9.24
152	Mill Creek to USGS 02225360	Stream	129.25	162.2	3.33
153	USGS 02225360 to Tiger Creek	Stream	128.12	161.9	5.9
154	Junction Tiger Creek (Branch 8)	Branch Jct	124.29	152.3	
155	Tiger Creek to Little Reedy Creek	Stream	124.29	152.3	3.39
156	Little Reedy Creek Tributary	Tributary	121.61	145.8	9.63
157	Little Reedy Creek to Reedy Creek	Stream	121.61	145.8	2.14
158	Reedy Creek Tributary	Tributary	119.5	139.7	19.56
159	Reedy Creek to Swift Creek	Stream	119.5	139.7	8.62

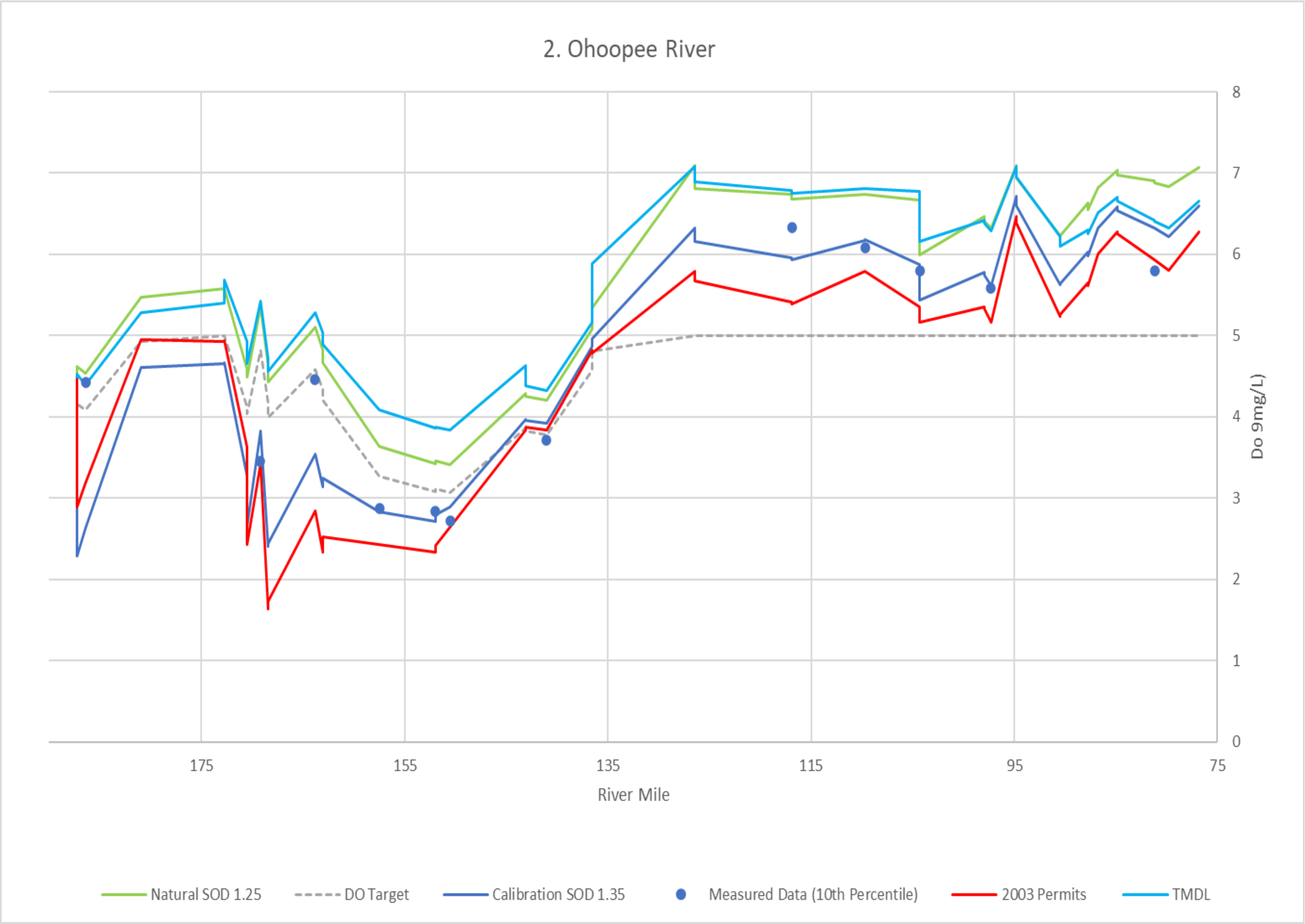
Reach No.	Reach Name	Reach Type	River Mile	Elevation ft msl	Drainage Area (sq miles)
160	Junction Swift Creek (Branch 9)	Branch Jct	113.81	120.8	
161	Swift Creek to UNT	Stream	113.81	120.8	0.46
162	Junction UNT to Pendleton Creek (Branch 13)	Branch Jct	112.58	119.6	
163	UNT Pendleton Creek to Little Creek	Stream	112.58	119.6	5.4
164	Little Creek Tributary	Tributary	111.25	112.1	7.35
165	Little Creek to Gage 022225470 (GA 86)	Stream	111.25	112.1	9.44
166	Gage 02225470 (GA 86) to Ohoopee River	Stream	106.08	99.1	0.79
EOB	End Branch		104.32		
	Branch 8: Tiger Creek				15.78
167	Tiger Headwaters to Bobtail Creek	Stream	139.27	224.3	6.905
168	Bobtail Creek Tributary	Tributary	136.21	202.3	9.07
169	Bobtail Creek to Naked Creek	Stream	136.21	202.3	2.334
170	Naked Creek Tributary	Tributary	135.05	192.3	4.813
171	Naked Creek to SR 297(us)	Stream	135.05	192.3	18.04
172	SR 279 to Victory Drive (USGS 02225371)	Stream	130.29	174.3	10
173	Victory Drive to Pendleton Creek	Stream	124.89	154.3	0.67
EOB	End Branch		124.29		
	Branch 9: Swift Creek				33.07
174	**Vidalia WPCP (GA0025488)**	Discharge	123.34	175.7	
175	Vidalia WPCP to Lyons North WPCP	Stream	123.34	175.7	17.13
176	**Lyons North WPCP (GA0033391)**	Discharge	118.31	144	
177	Lyons North WPCP to USGS 02225420 (GA152)	Stream	118.31	144	3.04
178	USGS 02225420 (GA152) to Pendleton Creek	Stream	117.24	141.2	2.81
EOB	End Branch		113.81		
	Branch 10: Spring Branch-Beards Creek				1.68
179	**Glennville WPCP (GA0037982)**	Discharge	72.42	97.5	
180	Glennville WPCP to Beards Cr/Hwy 196	Stream	72.42	97.5	2.25
181	Beards Creek	Tributary	70.7	77.7	83.19
182	Spring Br/Hwy 196 to Contour 70 ft	Stream	70.7	77.7	2.28
183	Contour 70 ft to UNT	Stream	69.57	70.1	2.37
184	Unnamed Tributary from right	Tributary	67.85	65.3	3.54
185	UNT to Hwy 23/USGS 02225860	Stream	67.85	65.3	1.27
186	USGS 02225860/Hwy 23 Contour 60 ft	Stream	66.89	62.6	0.51
187	Contour 60 ft to Contour 50 ft	Stream	65.95	60.1	1.82
188	Contour 50 ft to Mushmelon Creek	Stream	63.42	50.1	1.47
189	Mushmelon Creek	Tributary	61.18	46.6	22.07
190	Mushmelon Creek to Altamaha River	Stream	61.18	46.6	3.55
EOB	End Branch		58.57		
	Branch 11: UNT to Big Cedar Creek				1.24
191	**Wrightsville WPCP (GA0032395)**	Discharge	175.23	284.3	
192	Wrightsville WPCP to UNT	Stream	175.23	284.3	0.67
193	UNT to Big Cedar Creek	Stream	174.71	274.1	0.14
EOB	End Branch		173.78		
	Branch 12: Dyers Creek				1.18
194	**Tennille Pond (GA0049956) - Relocated to Oconee Basin**	Discharge	197.23	451.3	
195	Tennille Pond to UNT	Stream	197.23	451.3	2.06
196	UNT to Andrews Pond Creek	Stream	194.6	415	3.6
197	Andrews Pond Creek to Ohoopee River	Stream	191.24	373	3.89
EOB	End Branch		187.23		
	Branch 13: UNT to Pendleton Creek				1.38
198	**Lyons East WPCP (GA0033405)**	Discharge	115.33	170.8	
199	Lyons East WPCP to Tributary	Stream	115.33	170.8	2.21
200	Tributary to Pendleton Creek	Stream	113.38	132.3	0.57
EOB	End Branch		112.58		
	Branch 14: Jones Creek-Doctors Creek				85.04
201	USGS 02225950 to Ludowici WPCP	Stream	32.88	35.2	0.98
202	**Ludowici WPCP (GA0049166)**	Discharge	32.16	35.1	
203	Ludowici WPCP to Tributary	Stream	32.16	35.1	0.79
204	Tributary to Fountain Branch	Tributary	30.76	32.2	3.8
205	Tributary to Fountain Branch	Stream	30.76	32.2	1.33

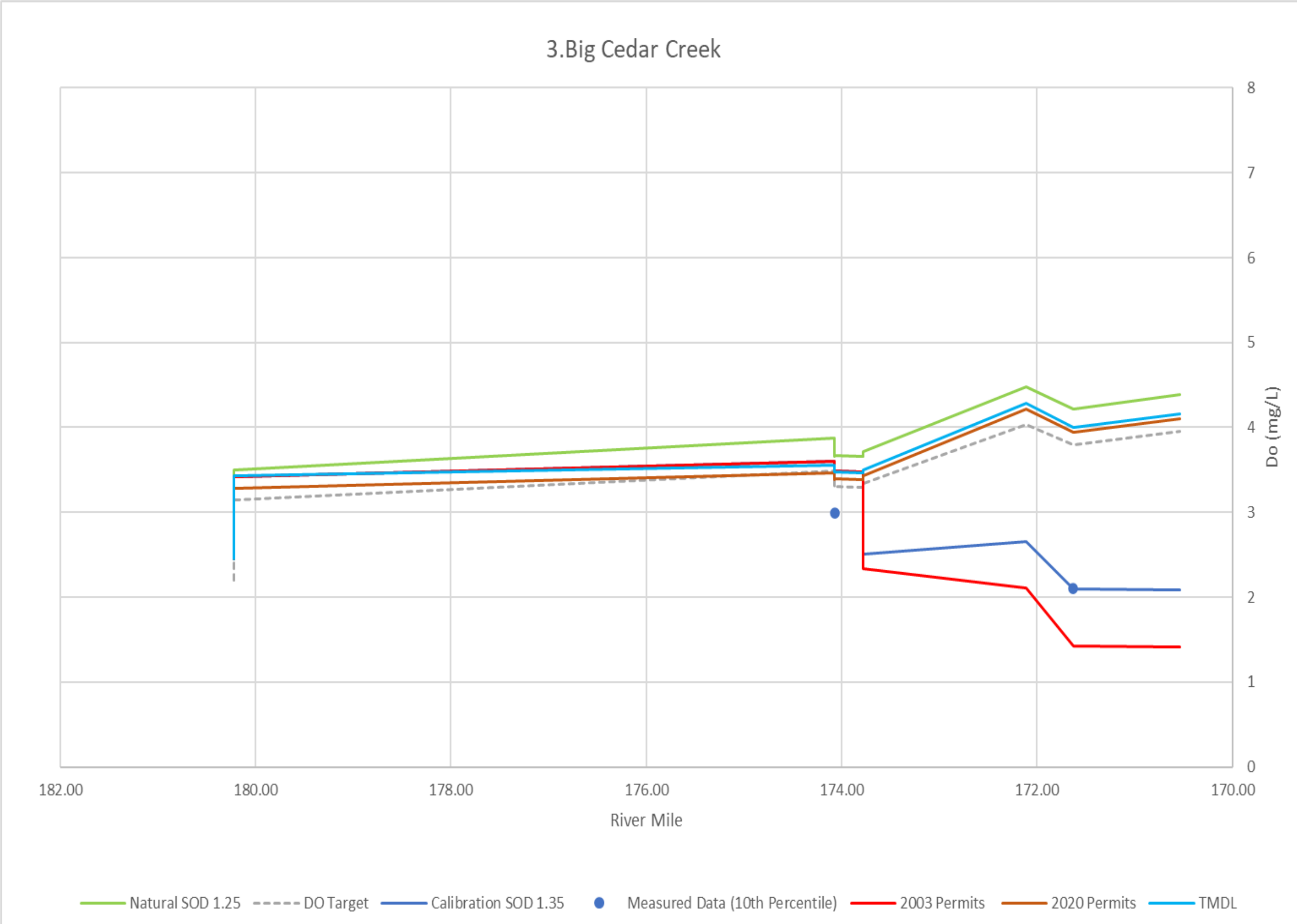
Reach No.	Reach Name	Reach Type	River Mile	Elevation ft msl	Drainage Area (sq miles)
206	Fountain Branch	Tributary	28.11	28.4	4.25
207	Fountain Branch to Conf of Jones Creek/Doctors Creek	Stream	28.11	28.4	1.24
208	Doctors Creek (USGS 02226060)	Tributary	25.91	24.7	57.71
209	Jones Creek/Doctors Creek to Altamaha River	Stream	25.91	24.7	37.95
EOB	End Branch		17.76		
	Branch 15: Cypress Creek				8.39
210	Rolands Pond to Flat Rock Branch	Stream	173.19	284.5	2.77
211	Flat Rock Branch	Tributary	170.31	254.5	2.05
212	Flat Rock Branch to Liberty Church Road (USGS 02225164)	Stream	170.31	254.5	0.68
213	(USGS 02225164) Liberty Church Road to Ohoopee River	Stream	169.32	246.5	0.51
EOB	End Branch		168.44		
	Branch 16: Sardis Creek				2
214	Unnamed Trib 1 to Unnamed Trib 2	Stream	172.43	293.2	1.87
215	Unnamed Trib 2 to USGS 02225238	Stream	171.39	278.2	1.46
216	USGS 02225238 to Unnamed Trib from left	Stream	170.33	266.2	1.07
217	Unnamed Tributary	Tributary	166.19	253.2	2.05
218	Unnamed Trib to GA 57	Stream	166.19	253.2	4.35
219	GA 57 to Little Ohoopee River	Stream	165.1	230.2	2.7
EOB	End Branch		162.84		
	Branch 17: Little Cedar Creek 1				0.25
220	**Harrison Pond (GA0037338)**	Discharge	184.75	347.1	
221	Little Cedar Creek 1	Tributary	184.75	347.1	1.05
222	Unnamed Tributary to Sheppard Branch	Stream	184.75	347.1	1.8
223	Sheppard Branch	Tributary	183.05	324.9	1.88
224	Sheppard Branch to Big Cedar Creek	Stream	183.05	324.9	3.35
EOB	End Branch		180.22	347.1	
	Branch 18: Cobb Creek				
225	**L.G.Herndon Jr Farms (GA0050231)**	Discharge	108.03	157.2	
226	UNT HW	Tributary	108.03	157.2	0.5
227	WPCP to Cobb Creek	Stream	108.03	157.2	1.41
228	Cobb Creek HW	Tributary	106.50	115.8	64.84
229	UNT to GA Hwy 56	Stream	106.50	115.8	6.5
230	GA Hwy 56 to Open Creek	Stream	104.30	107.3	5.37
231	Open Creek	Tributary	100.82	94.9	11.79
232	Open Creek to Altamaha River	Stream	100.82	94.9	9
EOB	End Branch		94.33		

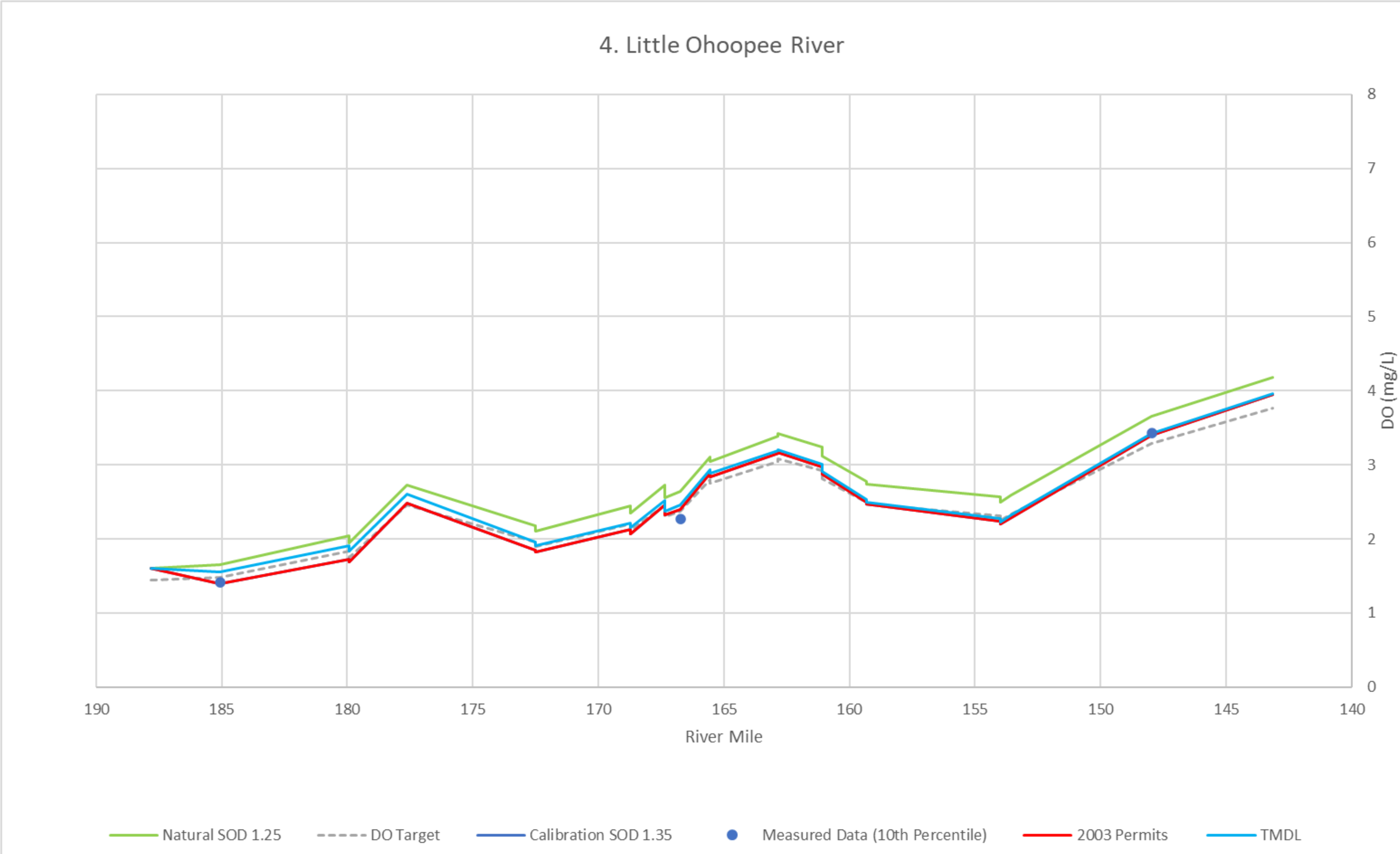
APPENDIX B

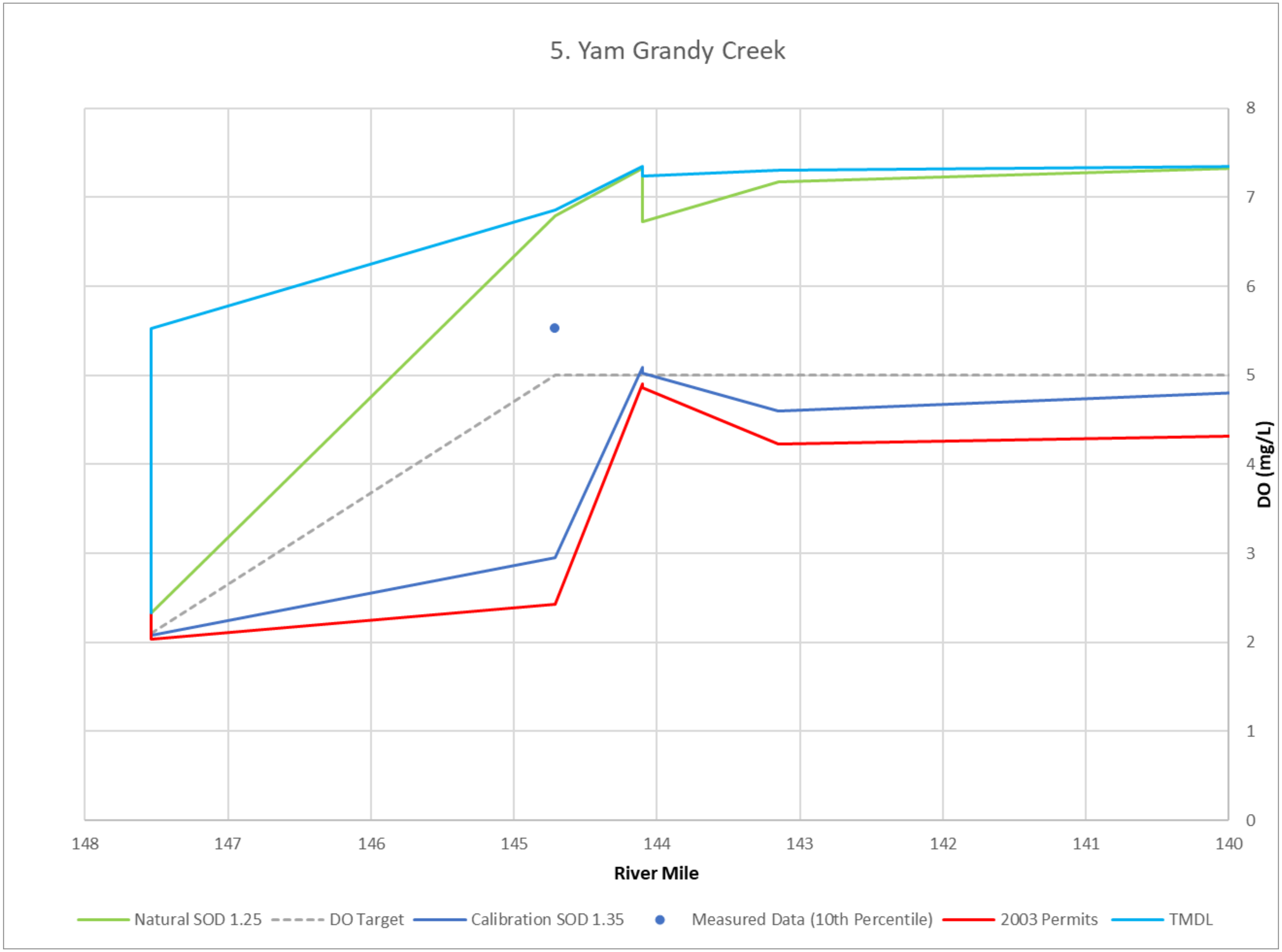
DOSAG MODEL RESUTS

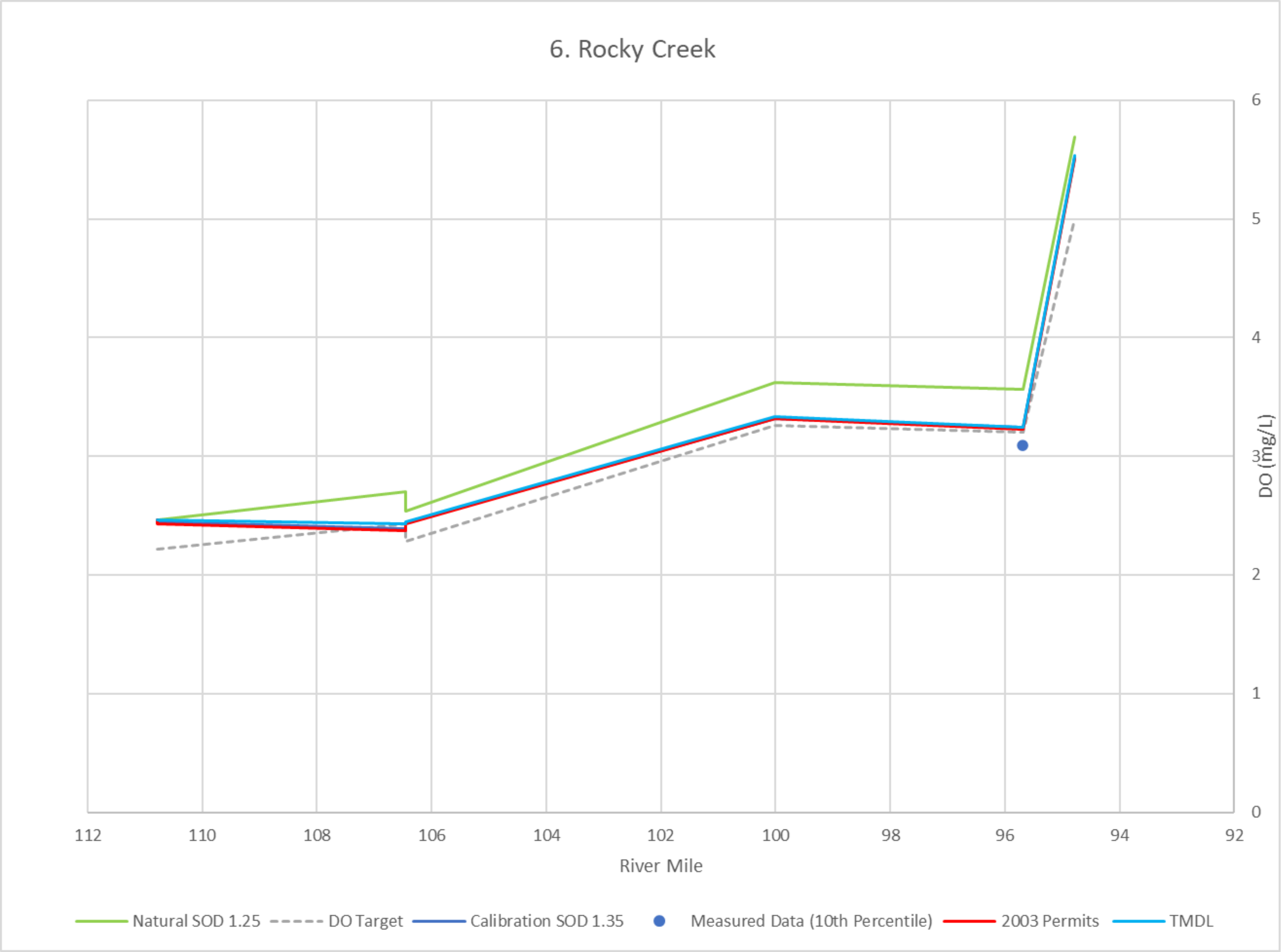

1. Altamaha River
8
7
6
5
4
3
2
1
0
DO (mg/L)
120
100
80
60
40
20
0
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
2020 Permits
TMDL


2. Ohoopee River
8
7
6
5
4
3
2
1
0
Do 9mg/L)
175
155
135
115
95
75
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
TMDL

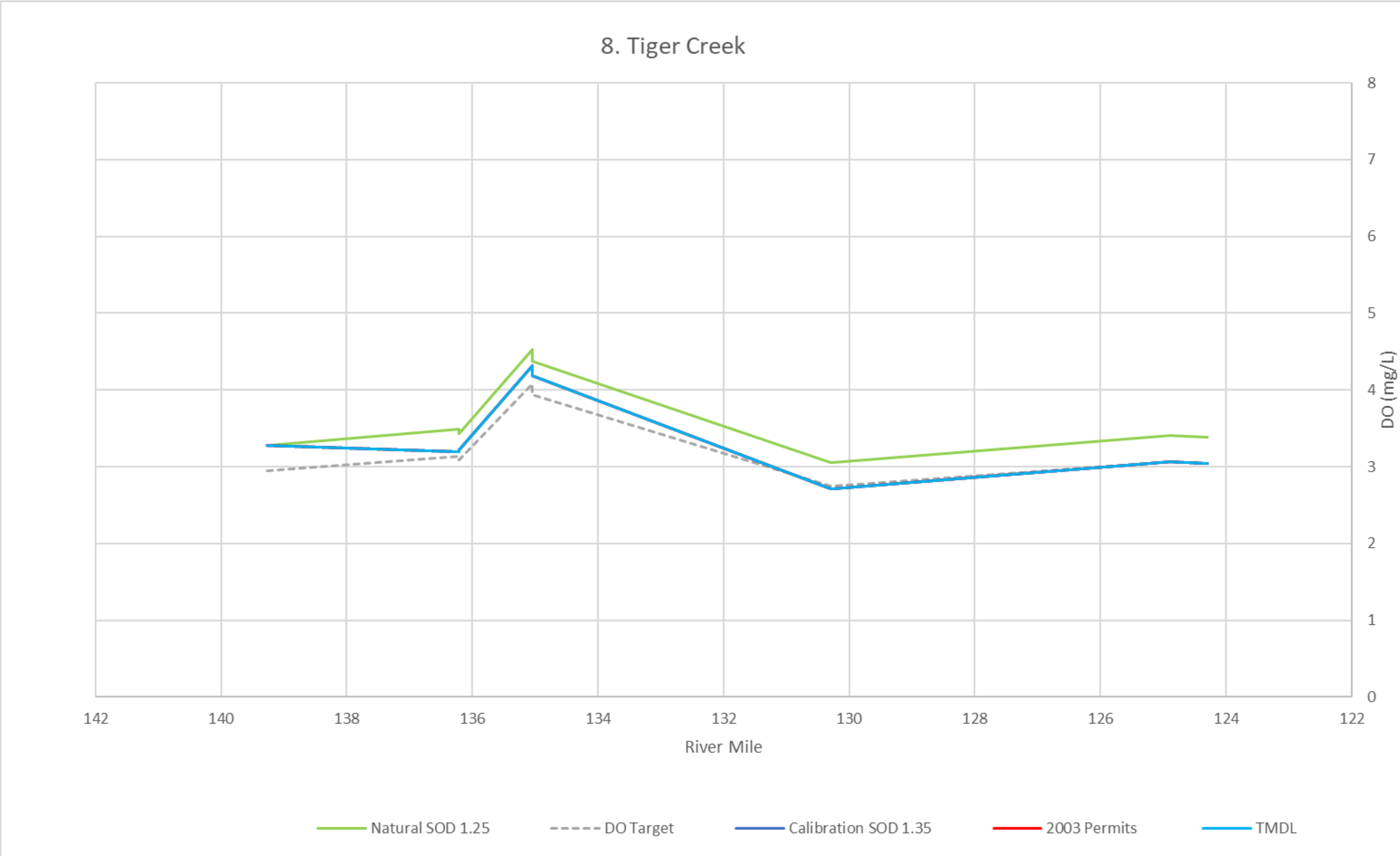

3.Big Cedar Creek
Do (mg/L)
River Mile
0
1
2
3
4
5
6
7
8
182.00
180.00
178.00
176.00
174.00
172.00
170.00
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
2020 Permits
TMDL

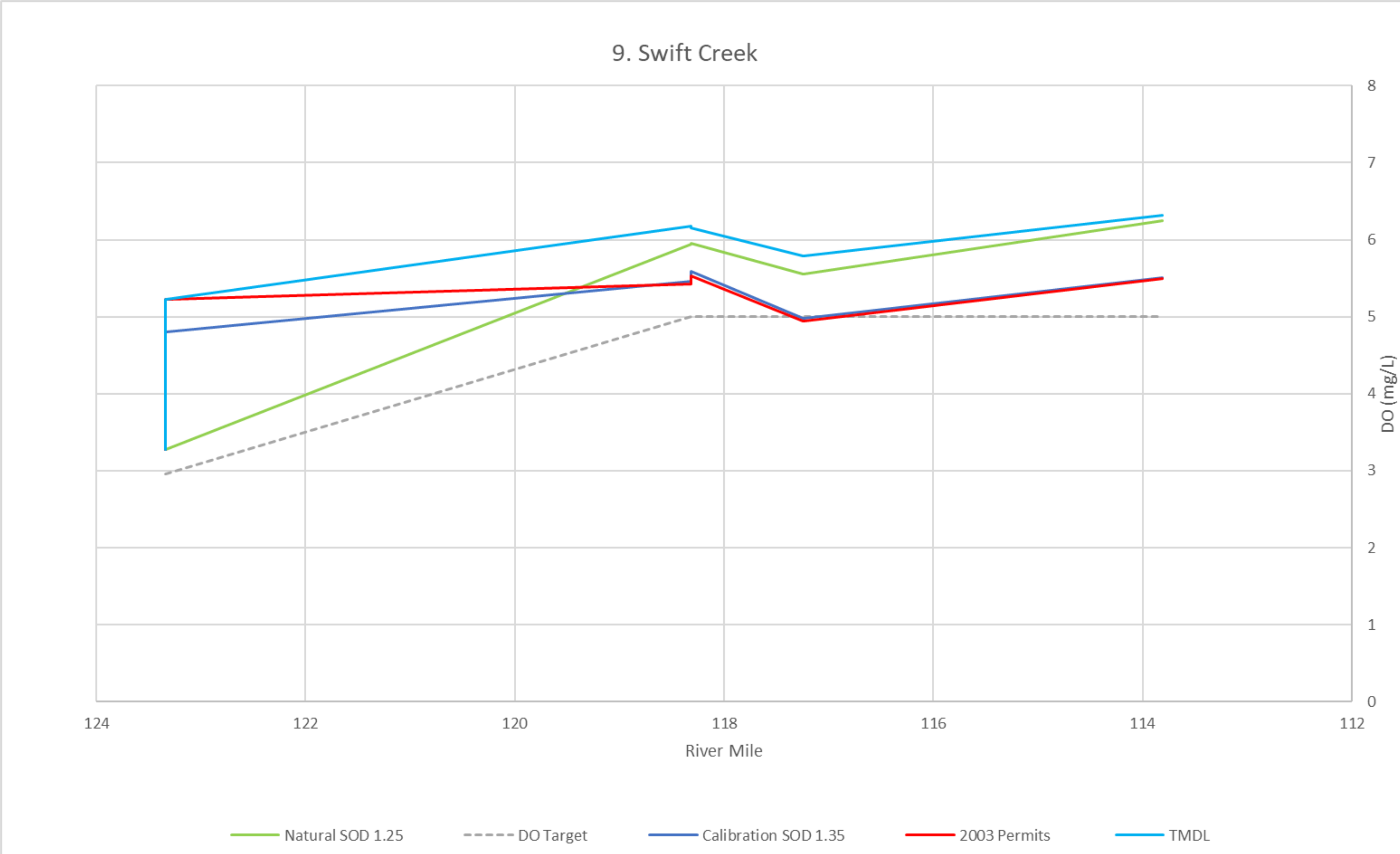

4. Little Ohoopee River
DO (mg/L)
8
7
6
5
4
3
2
1
0
190
185
180
175
170
165
160
155
150
145
140
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
TMDL

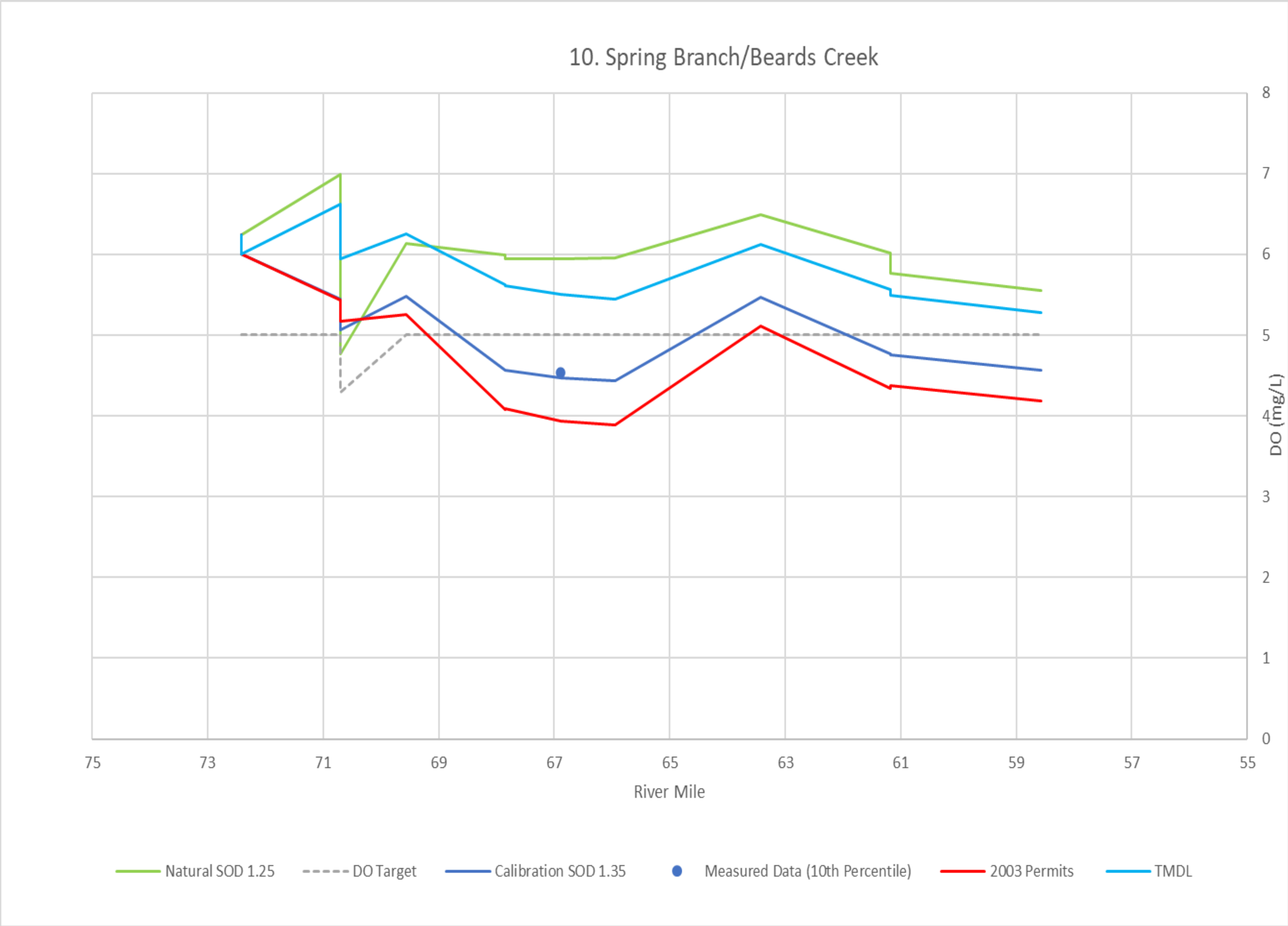

5. Yam Grandy Creek
8
7
6
5
4
3
2
1
0
DO (mg/L)
148
147
146
145
144
143
142
141
140
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
TMDL

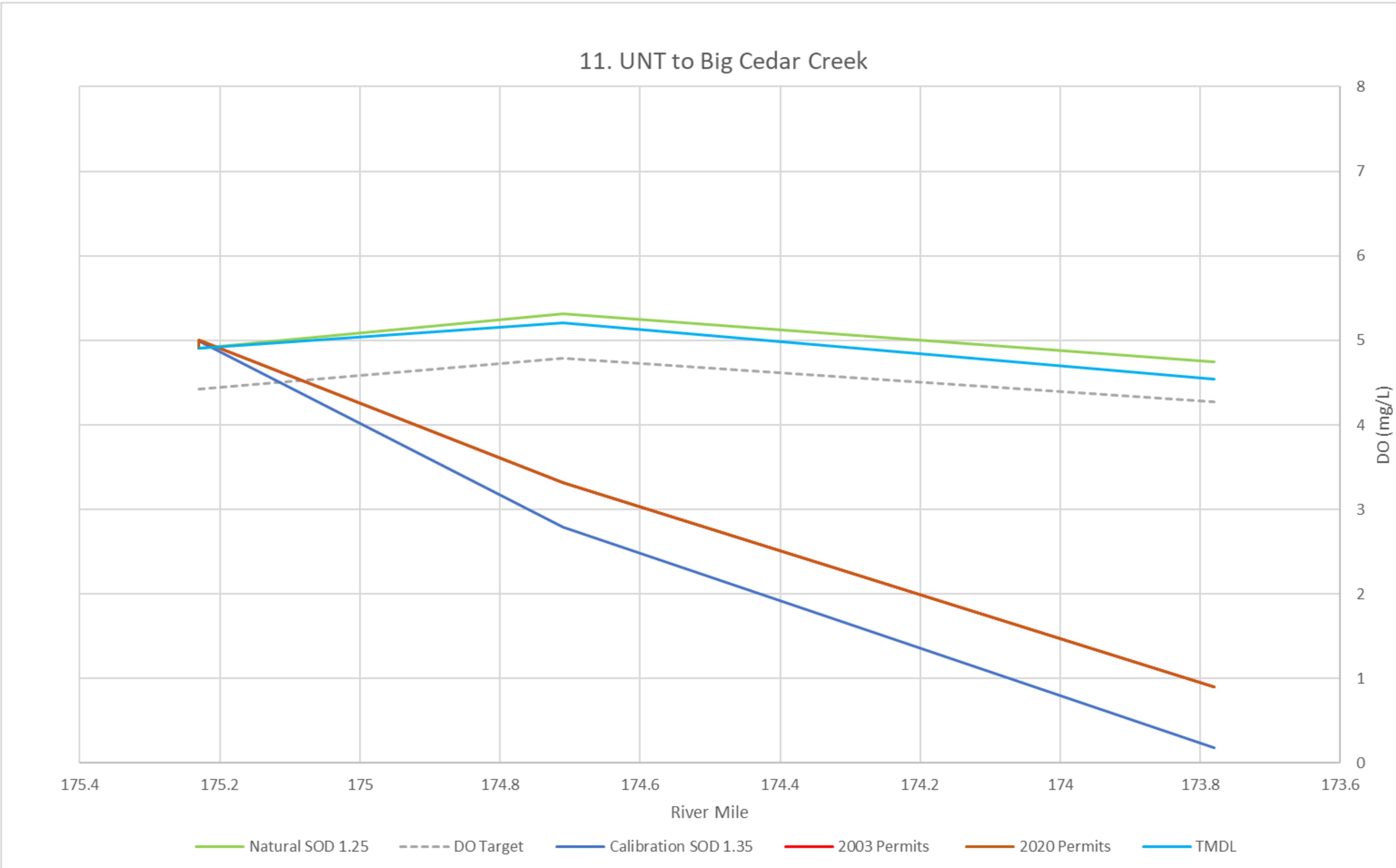

6. Rocky Creek
6
5
4
3
2
1
0
DO (mg/L)
112
110
108
106
104
102
100
98
96
94
92
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
TMDL

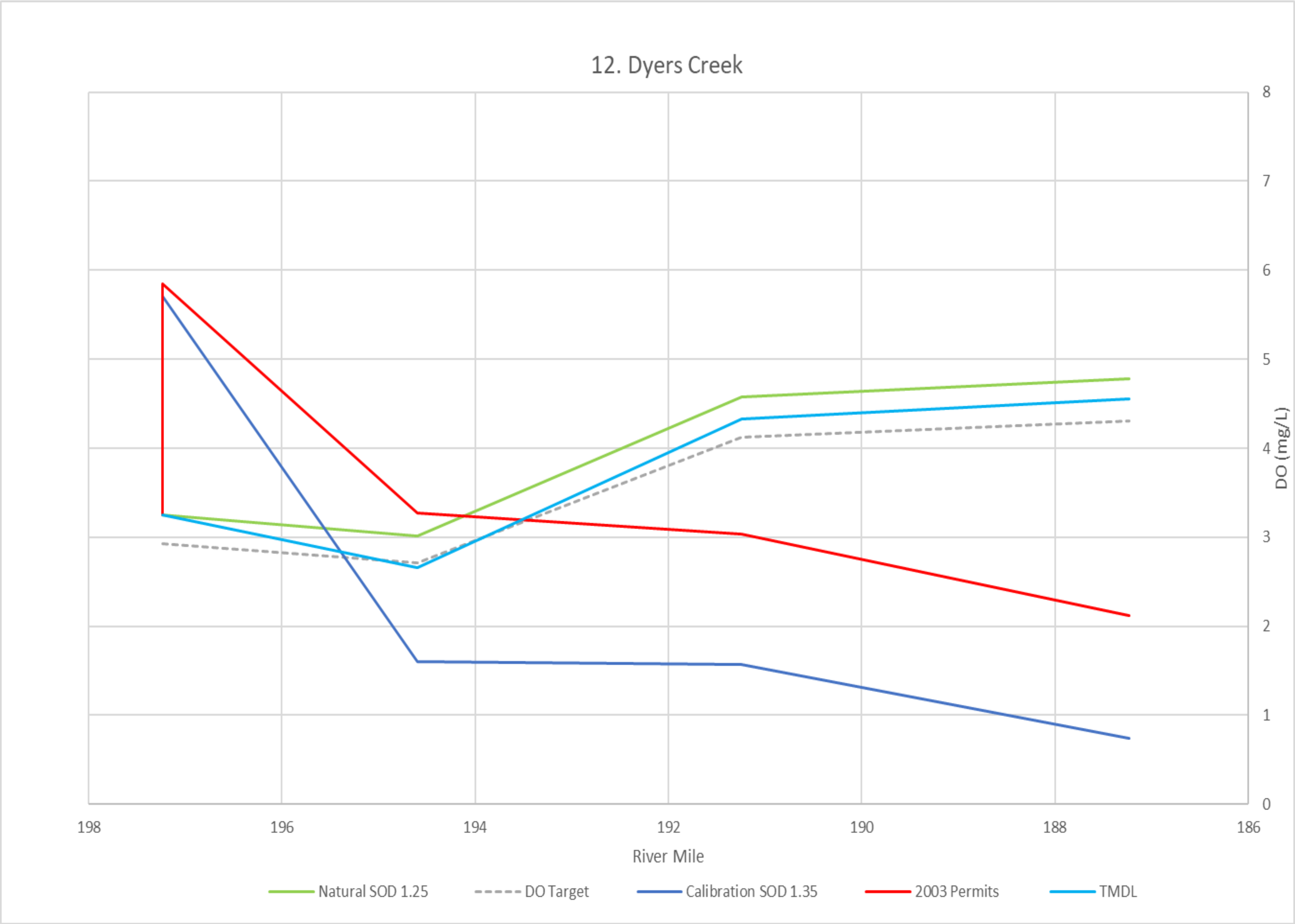

7. Pendleton Creek
8
7
6
5
4
3
2
1
0
DO (mg/L)
170
160
150
140
130
120
110
100
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
TMDL

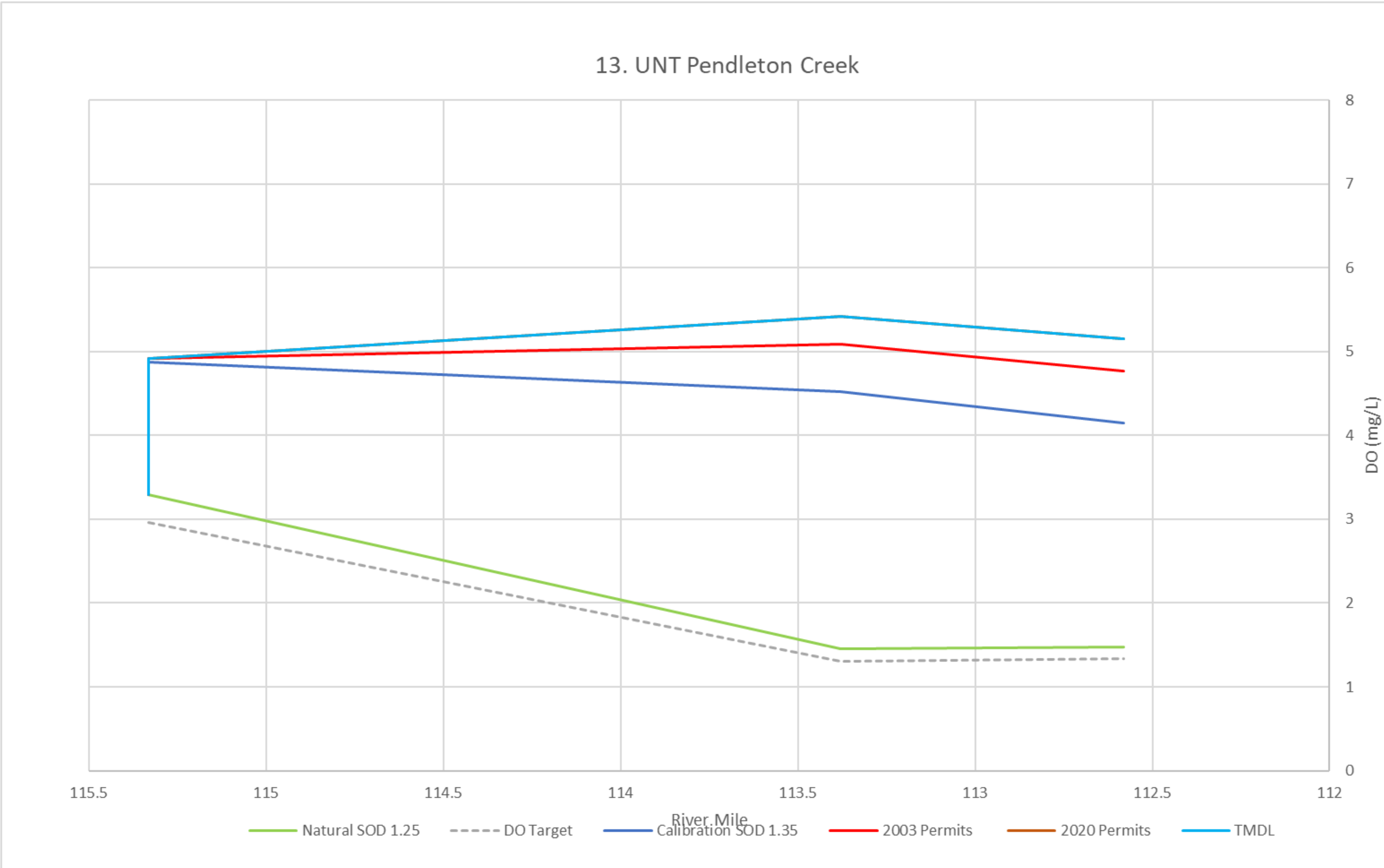

8. Tiger Creek
DO (mg/L)
0
1
2
3
4
5
6
7
8
River Mile
142
140
138
136
134
132
130
128
126
124
122
Natural SOD 1.25
DO Target
Calibration SOD 1.35
2003 Permits
TMDL

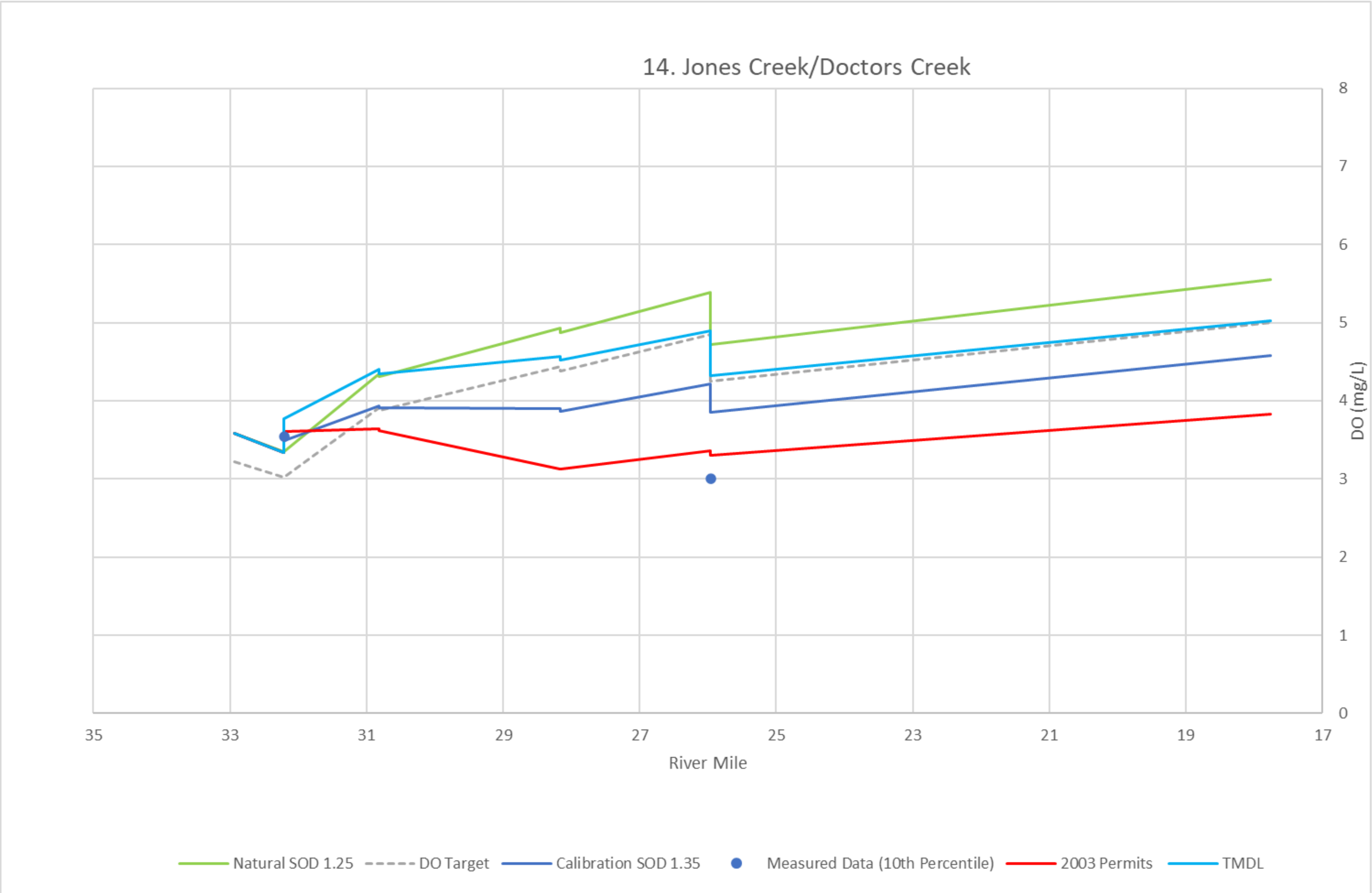

9. Swift Creek
8
7
6
5
4
3
2
1
0
DO (mg/L)
124
122
120
118
116
114
112
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
2003 Permits
TMDL

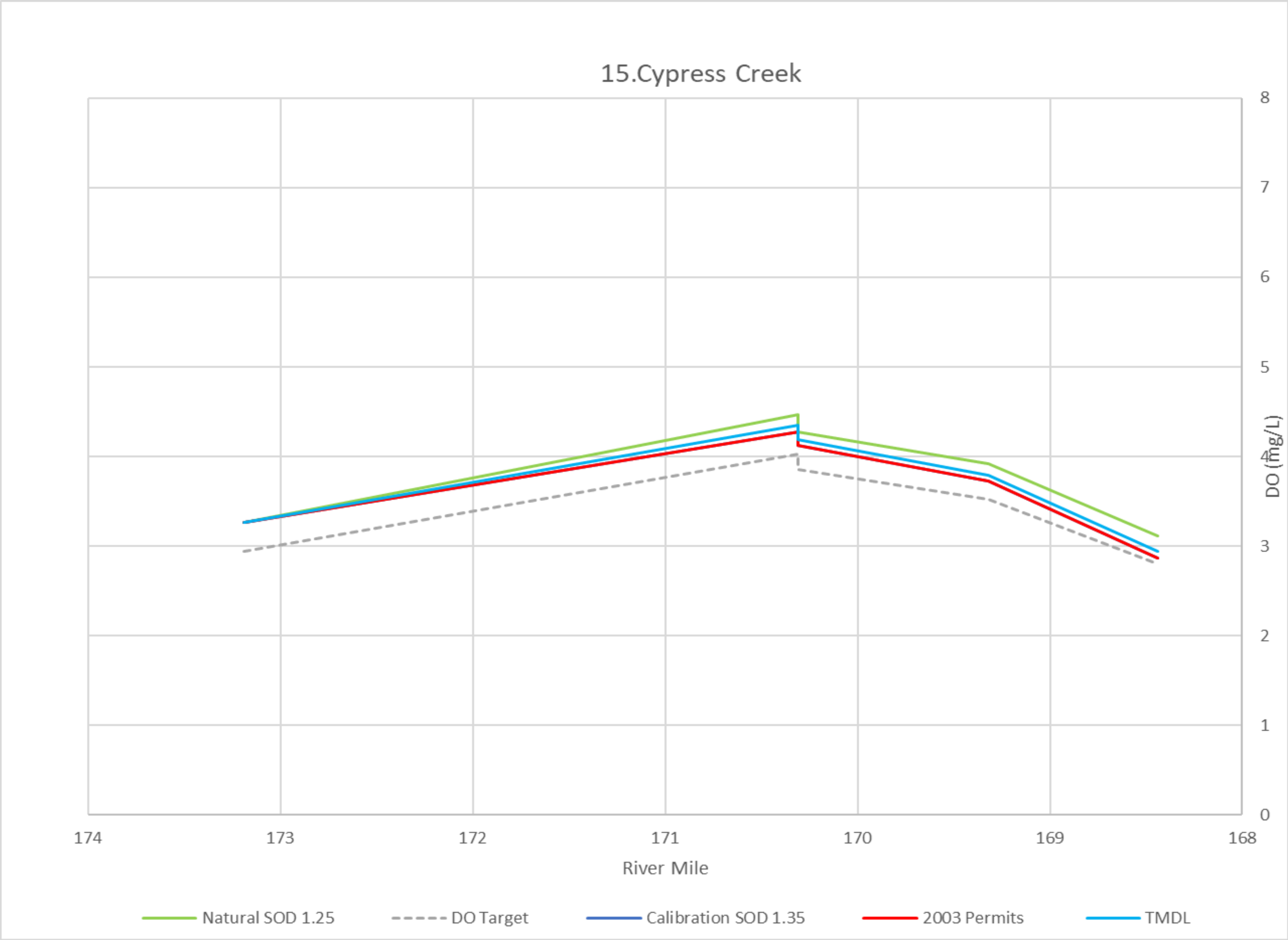

10. Spring Branch/Beards Creek
DO (mg/L)
0
1
2
3
4
5
6
7
8
75
73
71
69
67
65
63
61
59
57
55
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
TMDL

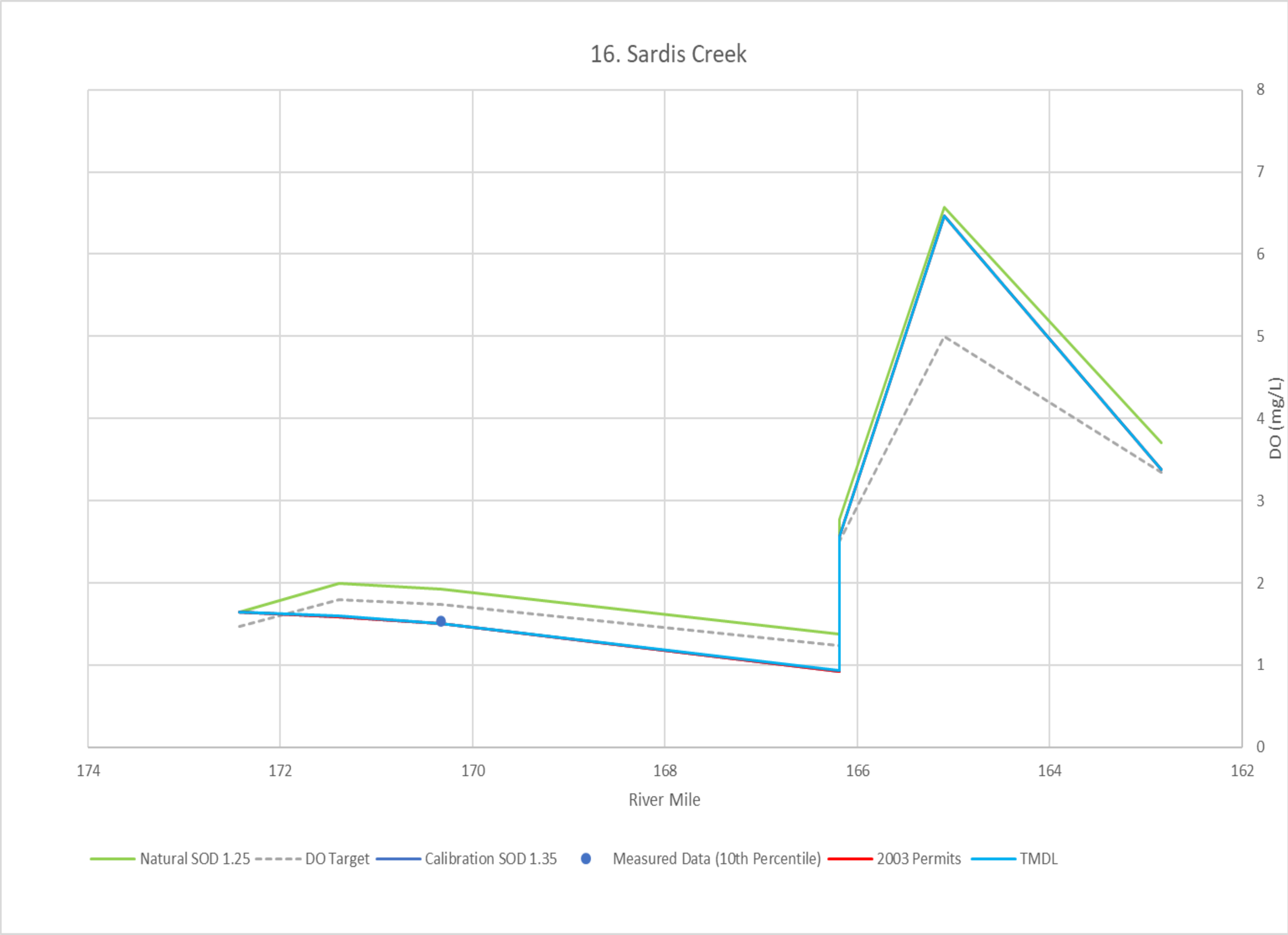

11. UNT to Big Cedar Creek
DO (mg/L)
8
7
6
5
4
3
2
1
0
175.4
175.2
175
174.8
174.6
174.4
174.2
174
173.8
173.6
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
2003 Permits
2020 Permits
TMDL

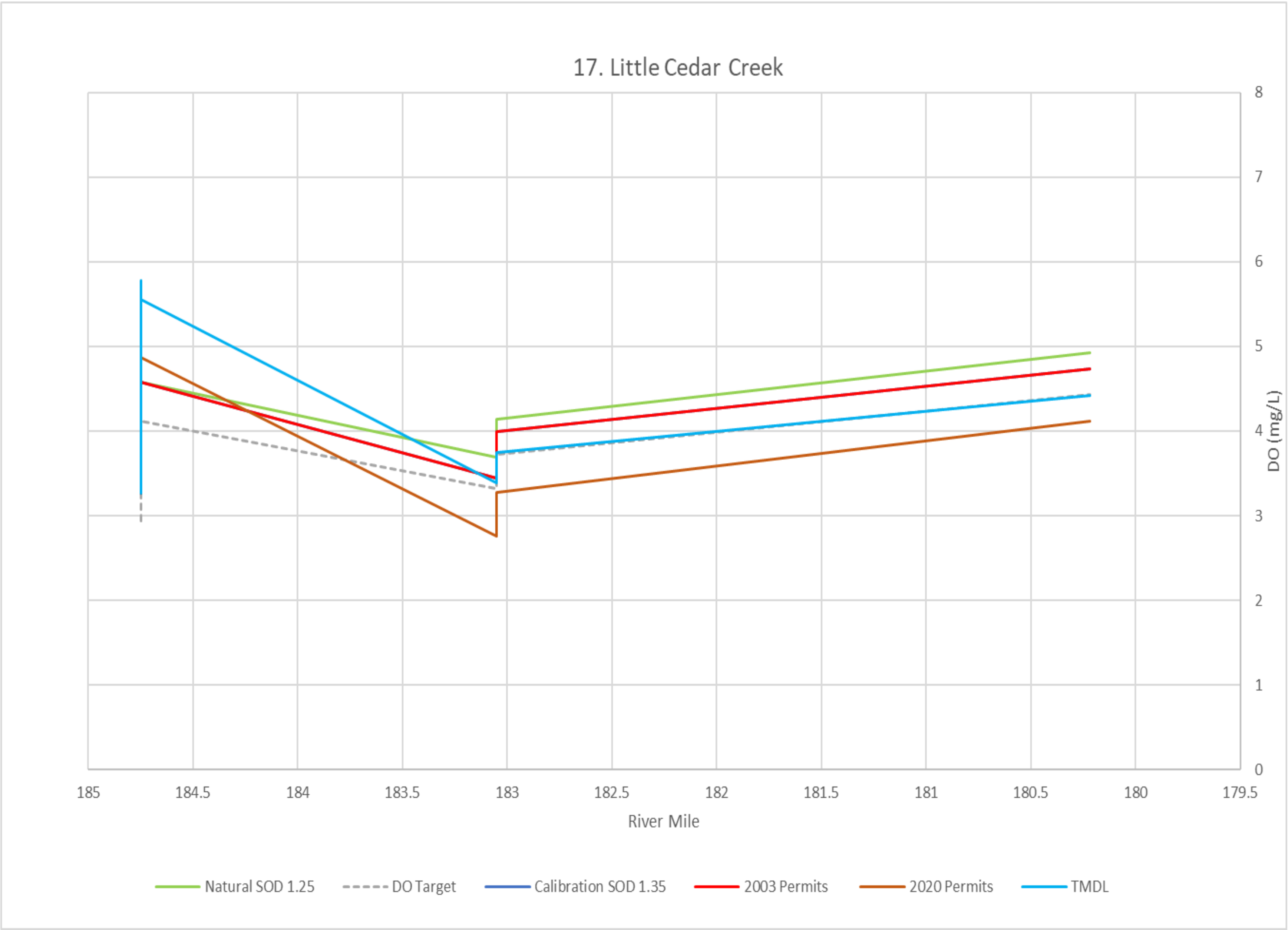

12. Dyers Creek
DO (mg/L)
0
1
2
3
4
5
6
7
8
198
196
194
192
190
188
186
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
2003 Permits
TMDL


13. UNT Pendleton Creek
DO (mg/L)
8
7
6
5
4
3
2
1
0
115.5
115
114.5
114
113.5
113
112.5
112
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
2003 Permits
2020 Permits
TMDL


14. Jones Creek/Doctors Creek
8
7
6
5
4
3
2
1
0
DO (mg/L)
35
33
31
29
27
25
23
21
19
17
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
TMDL


15.Cypress Creek
8
7
6
5
4
3
2
1
0
DO (mg/L)
174
173
172
171
170
169
168
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
2003 Permits
TMDL


16. Sardis Creek
8
7
6
5
4
3
2
1
0
DO (mg/L)
174
172
170
168
166
164
162
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
Measured Data (10th Percentile)
2003 Permits
TMDL


17. Little Cedar Creek
DO (mg/L)
River Mile
0
1
2
3
4
5
6
7
8
185
184.5
184
183.5
183
182.5
182
181.5
181
180.5
180
179.5
Natural SOD 1.25
DO Target
Calibration SOD 1.35
2003 Permits
2020 Permits
TMDL


18. Cobb Creek
8
7
6
5
4
3
2
1
0
DO (mg/L)
110
108
106
104
102
100
98
96
94
92
90
River Mile
Natural SOD 1.25
DO Target
Calibration SOD 1.35
2003 Permits
TMDL